Print ISSN: 1738-3110 / Online ISSN 2093-7717
doi: 10.13106/jds.2013.vol11.no11.41.

Study on the Effect of the Usability and Usefulness of Mobile Application Programs on Buying Intention*

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Abstract

Purpose –This paper aims to understand how easy and convenient it is for consumers to use mobile services. A mobile service combines hardware and software with information technology. To specifically meet the needs of users of mobile applications, the context of usability was identified in consumer mobile services.

Research Design, Data, and Methodology – For usability measurement and evaluation, appliances and software were the main target: this applied to an expanding range, such as a Personal Digital Assistant (PDA), mobile phones, and wired and wireless integrated services. This study extended the Technology Acceptance Model (TAM) by examining the roles of two characteristics of mobile applications'usage: usability and usefulness.

Results – The study tested the research model using a structural equation modeling (SEM) technique. Results showed no significant differences between the two models. Usability comprised learnability, efficiency, memorability, errors, and satisfaction: the motivation for using a mobile application was understood as being the usefulness and easy-of-use of the mobile application. This empirical study validated the proposed research model and hypotheses, and found that the hypotheses could be supported. Finally, the phenomena derived from the causal relationships in usability were identified, and their implications considered.

Keywords : Mobile Applications, Usability, System Acceptance Model, Buying Intension.

JEL Classifications : C52, C83, M31.

1. Introduction

In this study, emphasis was placed mobile service users how to take advantage of technology and services easy and convenient way is to understand how to use. Because mobile service that combines hardware and software information technology services for the product is combined, these technologies and services, so that it is easily accessible mobile services to provide convenient and user specific skills and to use them in advance, even if you do not know how to use them(Kim & Oh, 2007). In addition, even if made a user centered HCI(human computer interaction)based hardware and software, the user can easily make use of these devices should be accepted or used (Dillon, 2001; Johnson & Wiles, 2003; Kim & Oh, 2007; Oh & Choi, 2010; Oh & Lee, 2012). In this context, Information Technology Services to assess the acceptability easy to learn, can be used efficiently, and is easy to remember, few errors, such as user satisfaction and subjective factors to the evaluation it is important (Nielsen, 1996). For this purpose, 'the user and the information system without special training that allows you to easily write access, so that users can use in terms of information technology usability enhancements should be provided.

However, information technology or information systems to measure the performance of the system quality, information quality, system usage, user satisfaction, individual impact, and organizational impact of the measured variables presented as a "user satisfaction," a study to measure there is a one-to-many. In this case, the measurement results are less significant subjective and inconsistent can see the point (Delone & McLean, 2003; Kim & Oh, 2007; Oh & Lee, 2012). This information technology to accommodate the user's inner psychological state revealing developed a research model that can be limited to one. And information systems acceptance, usability, and cost-effectiveness as measured variables satisfy the user requirements for the proper understanding of this is provided by. In here, the information system to identify the degree of acceptance apply to usability is a key factor. So easy, even a user-friendly information technology It's not absolutely accept it, and the ability to use information technology should be described separately.

Usability, information technology and how easily you can access the system there and to assess the quality of the resulting

* This study was supported by grant of Jang An University, Korea and this study was modified by published in 2013 International Summer Conference of KODISA

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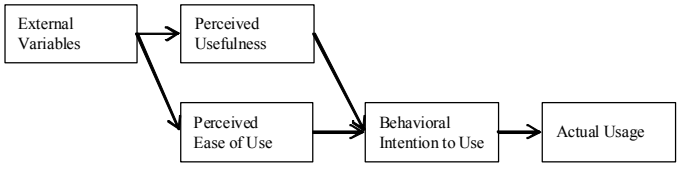
value is the attribute (Nielsen, 2005). Traditional usability studies on consumer electronics devices, S/W, a single product, such as Web sites and services was the main target. In recent years, personal digital assistants(PDA), mobile phones, etc. was done, and gradually for usability measurement and evaluation of the various wired and wireless integrated services, and extent of the change applies, is expanding (Brereton 2005; Kim & Oh, 2007; Oh & Choi, 2010; Oh & Lee, 2012).

In this study, Nielsen (1994) suggested using a model of the information system acceptance, mobile applications focusing on users, usability and purchase intention was to determine the correlation. To measure this, learning, efficiency, memory characteristics, such as error and enjoyment of each dimension of information system consisting of Acceptance Model (Nielsen, 1994) and the usefulness and purchase intentions (buying intention) on the effect on the relationship would hold. And Technology Acceptance Model (TAM: Davis, 1989) applied to the proposed extension of the research model, and for this analysis was to demonstrate.

2. Literature Study

2.1. Technology Acceptance Model

Information technology and information systems to accommodate the many theoretical models have been proposed research (Ajzen, & Fishbein, 1980; Davis, 1989; Davis et al., 1992; Moore & Benbasat, 1991; Taylor & Todd, 1995). Technology Acceptance Model of the use of information technology, the most reliable research model to explain the behavior and technology acceptance model and it is to be useful and has done extensive empirical support (Davis, 1989; Davis et al., 1992; Taylor & Todd, 1995; Venkatesh, 1999; Venkatesh & Davis, 2000).



Source: Venkatesh & Davis (2000)

<Figure 1> Technology Acceptance Model

On the other hand, a special information system, such as mobile service for users who use the system if you want to apply to, a new meaning to reveal the factors is a lack of information technology acceptance model. So, the information technology acceptance model there is a need to consider additional factors (Oh & Choi, 2010). In other words, information technology acceptance model with the particularity of the factors to consider as an information system, including through the improved usability and descriptive information must be presented the Technology Acceptance Model (Agarwal & Prasad, 1999).

In this context, Information Technology acceptance model for the use of information systems in different environments under different environments, the study of information technology adoption behavior can be seen (Davis et al., 1992; Venkatesh & Davis, 2000). The cable-based services such as information technology services and mobile wireless communications and wireless Internet-based information, new information technology environment, under extended technology acceptance model have been made and applied research (Agarwal & Prasad, 1998;Chau, 1996; Chau & Hu, 2002; Horton et al., 2001).

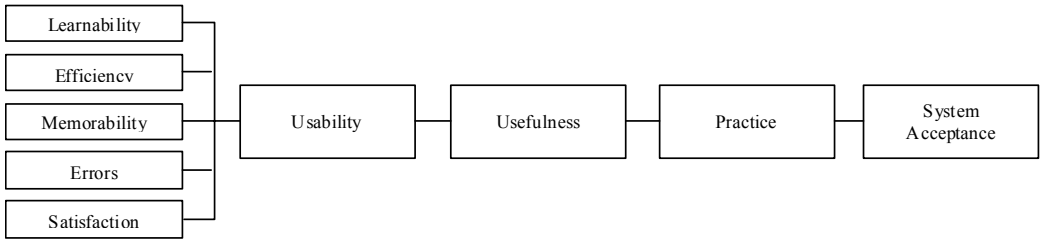
Therefore, in this study, existing technology acceptance model (Venkatesh & Davis, 2000) and use models of the base frame, and Nielsen(1994) presented a model of the information system by applying accommodate expanded research model is proposed.

2.2. Usability

What is usability, humans are designed to be easy to use HCI (Human Computer Interaction) has been started in the area (Schneiderman & Maes, 1997; Schneiderman, 2000). Analysis of the availability of products and systems, and information systems that can be used more easily to describe how user characteristics can be measure, and it is understood (Preece & Rogers, 2002).

Usability is a quality attribute that assesses how easy user interfaces are to use. The word "usability" also refers to methods for improving ease-of-use during the design process. And ISO defines 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." The word "usability" also refers to methods for improving ease of use during the design process (ISO9241-11). According to Nielsen (1994), he's early research information system acceptance performative forms of acceptance and social acceptance were separated. The operational acceptance of usability, cost, compliance, and includes factors such as reliability and availability of the system is described by the efficiency and usability. Here, the system usability, information systems have unique features that are available are described better <Figure 2>.

And usability is about a framework of system acceptability, where usability is a part of "usefulness" and is composed of five variables with learnability, efficiency, memorability, errors and satisfaction. Nielsen (1994), according to the initial study, the system for managing the learning ability, the basic functions must be easy to remember, error avoidance, and use them as the satisfaction of factors such as convenience and usefulness, which means they were called usability.



Source: Nielsen(1993)

<Figure 2> System Acceptance Model

3. Combined Modeling

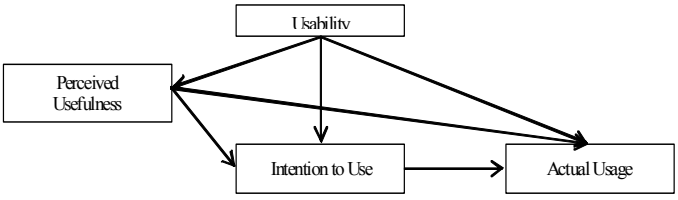
3.1. Adding the Usability to TAM

Davis et al.(1989) proposed the Technology Acceptance Model (TAM) to research the impact of technology on user behavior. The model focuses on the process of using technology, where "Perceived Usefulness" and "Perceived Ease of Use" are the two key factors that affect an individual's intention to use a technology. Perceived Usefulness means that the user believes the technology will improve his/her performance, while Perceived Ease of Use refers to the belief that using the technology will be free of effort. And Venkatesh and Davis (2000) suggested that Perceived Usefulness and Perceived Ease of Use could be affected by external variables. For example, they found that computer self-efficacy is an important variable and assumed that a positive relationship exists between higher computer self-efficacy on the one hand and Perceived Usefulness and Perceived Ease of Use on the other. The studies of Venkatesh (1999) confirmed the hypotheses about positive causal relationships posited in previous research. Since Davis proposed TAM, several approaches that focus on the degree of technological acceptance have been based on the model.

However, TAM only provides general information about whether a technology has been adopted by users. Further information is needed regarding its use in specific fields, so that the development of technology can be guided in the right direction. With the development of mobile applications usage, it is becoming an increasingly important usability. A growing number of mobile service users and they are being applied by technology in order to use ease of use. This study found that, in recent years, a number of users using mobile application have used Usability/TAM to examine users willingness to accept mobile service system and applications.

A suggested model of technology adoption, the information technology acceptance model (Neilsen, 1993), extends the TAM by considering how the usability affects usage. More specifically, the Nielsen's model suggests that technology usefulness depends in part on how well the new technology fits the requirements of an ease of use software and hardware. Therefore, there are two prevailing definitions proposed by Nielsen (1994) and ISO 9241-11(1995). Nielsen (1994) proposed that usability has five characteristics: learnability, efficiency, memorability, errors, and subjective satisfaction (refer to <Figure 2>).

Under the notion of product quality, usability concepts can be applied to hardware and software products. This definition integrates traditional usability and utility into a broader usability definition that includes utility issues. This study will adopt this definition in this Technology Acceptance Model (TAM). However, this definition is too general to be used directly. This study have to develop measurable usability criteria for mobile service and mobile application programs usage based on this general definition <Figure 3>.



<Figure 3> Added Model to the TAM

3.2. Hypothesis

It is expected that perceived usefulness will influence intention to use and the actual use of online shopping activities. Perceived ease of use will influence intention to use and intention to use will influence actual use of online shopping activities. As Davis (1989) showed, beliefs about perceived usefulness and perceived ease of use influence the actual outcomes. Therefore, the following hypotheses are proposed:

Hypothesis 1a: Perceived usefulness is positively related to the intention to use Hypothesis

1b: Perceived usefulness is positively related to actual usage

Hypothesis 2: The TAM predicts intention to use and actual use.

The system acceptance model suggests that individuals not only consider beliefs about perceived usefulness and perceived ease of use, but also the extent to which mobile service usage activities meet their usefulness and individual ease of use (Nielsen, 1994). The following hypotheses are proposed:

Hypothesis 3a: Usability is positively related to perceived usefulness.

Hypothesis 3b: The added Usability/TAM predicts the intention to use

Hypothesis 3c: The added Usability/TAM predicts the intention to actual use.

4. Methodology and Results

4.1. Subjects

Data were gathered with a survey questionnaire, containing questions focusing on demographics and scales measuring the variables in the research model. Confirmatory factor analysis (CFA) was carried out to establish factorial validity and the structural equation modeling (SEM) was used for model comparison and hypotheses testing.

A self-report questionnaire was used in this study. In addition to providing their demographic information, participants were required to respond to 13 items, specifically, perceived usefulness (4 items), intention to use and actual usage (4 items) and usability (5 items). Respondents were asked to indicate the items on a 7 Likert scale whether they strongly disagree (1), slightly disagree (3), slightly agree (5) and strongly agree (7) with the statements. These items were adapted from various published sources. Samples in this study were 441 college students from near- by Seoul and Daejeon province in Korea.

<Table 1> Measurement Items and Definition

Variables		Terms	Description
Usability (Nielsen, 1994)	Learnability	1	How easy is it for users to accomplish basic tasks the first time they encounter the design?
	Efficiency	1	Once users have learned the design, how quickly can they perform tasks?
	Memorability	1	When users return to the design after a period of not using it, how easily can they'reestablish proficiency?
	Error	1	How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
	Satisfaction	1	How pleasant is it to use the design?
Usefulness (Davis, 1989)		4	The degree to which a person believes that using a particular system would enhance his or her job performance.
Intention to use (Ajzen, 1989)		4	An indication of an individual's readiness to perform a given behavior.
Actual Usage Davis & Venkatesh, 2000)		4	It is assumed to be an immediate antecedent of behavior

4.2. Data analysis

<Table 2>shows the value of Cronbach's alpha, the variance extracted from all the constructs, and the descriptive statistics of the mean and standard deviations of all the items in the questionnaire. According to Nunnally and Bernstein (1994), Cronbach's alpha is reliable if its value is at least 0.7.

The factor loadings of the individual items in the seven constructs are all above 0.5, as shown in <Table 2>. Moreover, there is no evidence of cross loading, which means the questionnaire was well designed. Initially, the questionnaire contained 13 items.

<Table 2> Cronbach's alpha & discriminant validity

Construction	Factor loading						
	1	2	3	4	Eigen Value	AVE (>50)	Cronbach' α
Usability	0.727	0.165	0.197	0.147	3.498	10.930	.8566
Usefulness	0.778	0.703	0.634	0.636	2.526	7.895	.8649
Intention to Use	0.500	0.614	0.629	0.882	2.768	8.649	.7821
Actual Use	0.592	0.666	0.574	0.519	3.293	10.291	.6556

To ensure that the constructs (Usability, perceived usefulness, intention to use and actual use) had high validity, composited reliability, average variance extracted (AVE) and discriminate validity of each construct were examined. The composite reliability of each construct was assessed using Cronbach's alpha. And according to Hair (2010), in order to ensure the AVEs index were adequate for testing structural equation modeling, it should equal or exceed 0.50. <Table 2>showed that the AVEs for each measure exceeded 0.50. This meant that more than one-half of the variance observed in the items was accounted for by their hypothesis factors. Factor loadings, composited reliability coefficient and AVE met the recommended guidelines, indicating that the convergent validity for the proposed constructs of the measurement model was adequate for structural equation modeling.

4.3. Measurement model validation

A confirmatory factor analysis (CFA) was conducted to test the factor structure of the 12-item scale using AMOS. The four

latent constructs were assumed to be correlated. The overall fit model for the final measurement model was estimated to ensure a good data fit with the model <Table 3>.

The four fit indices (Good-of-fit): χ^2 goodness-of-fit statistic, χ^2/df, Goodnees of Fit (GFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Standardized Root Mean Square Error of Approximation (RMSEA) were assessed. Absolute fit indices measured how well the proposed model reproduced the observed data. According to Hair (2010), the value of GFI and CFI should be more than 0.95 and RMSEA smaller than 0.05 to be considered good fit. For χ^2/df, the value below 3 was considered acceptable. TLI value should be greater than 0.90. The 13 item scale indicated some improvement of model fit and met the minimum thresholds for acceptable model' fit. Table 1 provided a summary of the estimated fit indices of the final measurement model.

<Table 3> Good-of-fit indices for the measurement model

Fit indices	Criteria	Revised Model	Measurement Model
χ^2	Preferably smaller	1058	1177
d.f.	Preferably higher	536	561
p-value	< 0.05	0.00	0.00
χ^2/d.f.	< 2.0 ~ 5.0	2.54	5.08
GFI	> 0.8 ~ 0.9	0.96	0.88
AGFI	> 0.8 ~ 0.9	0.93	0.85
NFI	> 0.8 ~ 0.9	0.89	0.87
TLI	> 0.8 ~ 0.9	0.91	0.87
CFI	> 0.8 ~ 0.9	0.90	0.88
RMSEA	< 0.05 ~ 0.08	0.07	0.09

4.4. Structural model validation

The software package AMOS18 was used to test the research model using a structural equation model approach (SEM). A similar set of model-fit indices was carried out to test the structural model of the study. The four fit indices were χ^2/df, GIF, AGFI, CFI, TLI and RMSEA. Several models were analysis. Results showed that there were no significant differences between the two models (Constrained Model: χ^2 =1177; χ^2/df =2.098; GFI=.881; AGIF=.850; CFI=.880; TLI=.972 and RMSEA = 0.09.

4.5. Hypotheses Testing

<Table 4>showed parameter estimates for hypothesis model. Hypothesis H1, H2 and H3 were supported by the data. Usability was a significant influence on perceived usefulness of mobile applications (β=.32, p<.00), intention to use (β=.26, p<.00) and actual use (β=.65, p<.00). Perceived usefulness was a significant influence on intention to use mobile applications (β =.53, p<.00) and actual use (β=.53, p<.00). Finally, actual use were found to be influenced by intention to use mobile applications towards actual use (β=.32, p<.00).

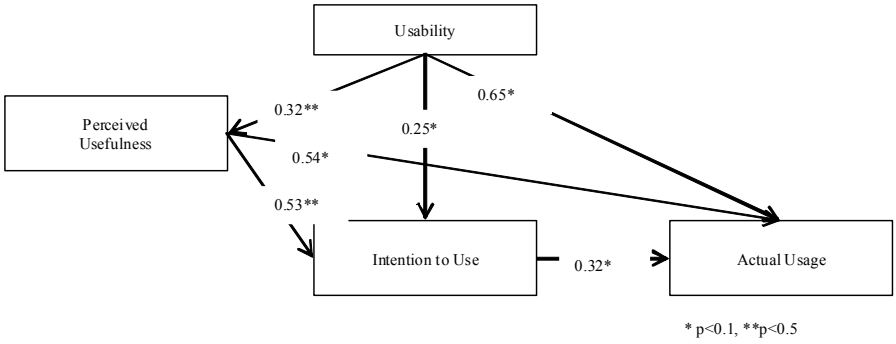
<Table 4> Result of hypotheses test

Hypotheses	Estimate	S.E.	C.R.	P	Acceptance
Usability to Usefulness	0.321	0.044	7.233	0.000	accept.
Usability to Intention to use	0.255	0.033	7.498	0.000	accept.
Usability to Actual Use	0.650	0.075	8.291	0.000	accept.
Usefulness to Intention to use	0.541	0.131	6.904	0.000	accept.
Usefulness to Actual Use	0.530	0.075	7.378	0.000	accept.
Intention to use to Actual Use	0.322	0.045	7.640	0.000	accept.

5. Conclusion

The goal of this research, which is based on the TAM model, is to add new variables, usability, to the model and explore whether users are willing to use an mobile application programs. This empirical study validates the proposed research model and hypotheses, and found that the hypotheses can be supported. Finally, it was identify the phenomena that derive from the causal relationships in usability, and consider their implications.

Applications of information technology in mobile service are becoming more and more sophisticated, and can make up for the limitations of hardware and software. The main purpose of this study is to provide guidelines for establishing an mobile applications usage. And in this study, it is to be described the further development of such mobile applications usage from the



<Figure 4> Standardized path coefficients for all respondents

perspective of external variables like a Usability. In terms of mobile applications usage, because users have different proficiency levels, the system compiles each user"s skills in advance in order to mobile applications usage adapted for individual users. In terms of User-interface applications, the service provider of mobile carrier provides users with comfortable and easy to use, user-centered and personalized interfaces with usability.

The contribution of this research is that it adds external variables usability to the TAM to explore the use of mobile application programs. As this is list several implications of the research results as guidelines for developing future mobile applications.

(1) The Intention to Use mobile applications is strongly and directly affected by Perceived Usefulness and by Usability. Thus, when developing mobile applications, by developing user-centered programs, the service provider must have view point of that users feel the learnability, efficiency; no errors, easy memorability and satisfaction with fun application programs are helpful.

(2) Users should be encouraged to gain more useful experience and to ease of use information technology to applications. For example, users could use other mobile applications so that it is easier to adapt and use to a possibly more complicated technological environment in the future.

(3) Some advanced applications should be considered when designing the user interface.

Received: September 20, 2013.
Revised: October 16, 2013.
Accepted: November 14, 2013.

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