A Structural Equation Model to Examine Mobile Application Usability and Use

Araştırma Makalesi/Research Article

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***Abstract*—** The aim of this study is to adapt the mobile application usability scale to the Turkish culture and test its nomological network within a structural measuring model. The model is based on the technology acceptance model. Considering the relationships between usability perceptions, continued intention to use, brand loyalty and actual use of mobile applications of the users, these four variables were included in the model. The study was conducted on 476 participants. Translation of the scales, confirmatory factor analysis, and reliability tests were conducted to test the validity and reliability of the scales. The original construct of the three scales validated by confirmatory factor analysis. Cronbach's alpha coefficients were high or at least acceptable for all constructs. Fit indexes of the model indicated that the model remains within the acceptable limits. Relationships between usability, continued intention to use, brand loyalty and actual use were validated with the sample data.

***Keywords*—** mobile application, usability, actual use, intention, brand loyalty, tam, scale adaptation, validity

Mobil Uygulama Kullanılabilirliğini ve Kullanımını İncelemek İçin Bir Yapısal Eşitlik Modeli

***Özet*—** Bu çalışmanın amacı, mobil uygulama kullanılabilirliği ölçeğini Türkçeye uyarlamak ve bir yapısal ölçüm modeli içinde kendi nomolojik ağını test etmektir. Çalışmada kullanılan model, teknoloji kabul modeline dayanmaktadır. Kullanılabilirlik algıları, kullanmaya devam etme isteği, marka sadakati ve kullanıcıların mobil uygulamalarının fiili kullanımı arasındaki ilişki göz önüne alınarak, bu dört değişken modele dahil edilmiştir. Çalışmada 476 katılımcıdan veriler toplanmıştır. Ölçeğin geçerlik ve güvenilirliğini test etmek için ölçeklerin çevirisi, doğrulayıcı faktör analizi ve güvenilirlik testleri yapılmıştır. Doğrulayıcı faktör analizi ile üç ölçeğin orijinal yapısının Türkçe için korunduğunu göstermiştir. Cronbach alfa katsayıları tüm yapılar için yüksek veya en azından kabul edilebilir çıkmıştır. Modelin uyum indeksleri, modelin kabul edilebilir sınırlar içinde kaldığını göstermiştir. Kullanılabilirlik, kullanma isteği, marka sadakati ve fiili kullanım arasındaki ilişkiler çalışma verileriyle doğrulanmıştır.

***Anahtar Kelimeler*—** mobil uygulama, kullanılabilirlik, kullanım, istek, marka sadakati, tam, ölçek uyarlama, geçerlik

1. INTRODUCTION

The use of mobile phones has been increasing recently, especially in the last decade. Those phones have touch screens and provide various functions including communication [1] and are small enough to be carried in pockets or purses. Nowadays people mostly refer those devices as mobile devices or mobile phones which also can be called smartphones. Most of those devices, particularly recent ones can compete with personal computers both hardware and software except for their screen sizes. Their sizes or screen sizes in particular may seem as disadvantages at first but because they are easy to carry and some people do not want to carry a second and relatively bigger and heavier device along with, they are not. Some people prefer to use their smartphones for their all

information and communication needs and find them more practical than notebook or tablet pcs [2-7]. The increasing in the use of such devices [2, 3, 8] brings an increase in the use of mobile applications [3, 7, 9, 10] along with. This increase is followed by another increase which is in the amount of mobile applications. Hence users can find a bunch of applications for any (even for the simplest) function/task. But only some of these applications continue to be used by a significant number of users. On the other hand, users' usage scope and demands about mobile applications increase day by day [11]. Thus, developing mobile applications that address users' needs and demands may require new approaches or instruments.

User's first impression of a mobile application can be a decisive factor affecting his/her intention of using the application [11, 12]. Some modifications to generate a good first impression and increase the usability of the applications were reported to have some good effects [8]. Hence, usability may have an effect on actual use of an application. Besides, usability is considered to be an important dimension of an assessment process of a software/application [14, 15]. Usability may also be one of the most important constructs of a well-designed mobile application [8, 16]. Attard, Mountain [3] draws attention to this field and suggest to conduct studies that examines the factors that affecting users use of mobile devices thereby mobile applications.

Lots of firms, especially big firms from different sectors invest in their products usability [17-19]. They also invest in mobile applications that would support their efficiency and effectiveness [3]. Particularly, dominant firms of information and communication field such as Microsoft, Apple and Google pay a significant consideration to this matter and they even orchestrate some standards or guidance to develop more usable mobile applications. But most of these standards or guidance stay at principal level and mostly have no practical implications. On the other side, using design guidance is recommended for a mobile application development process [7, 13, 15, 20]. Such a use may help in developing more usable mobile applications and/or address the demands of users [14]. Hoehle, Aljafari [21] developed a Mobile Application Usability Scale (MAUS) to fill the gap in the field. They suggest to conduct studies to validate MAUS for different cultures. The aim of this study is to adapt MAUS into the Turkish culture and test its nomological network within a structural equation model (Figure 1). The original study was conducted with the participation of German consumers, the current study was conducted with participants form eastern Turkey. Since Germany is considered as a developed and well established country in social, educational, economic and cultural dimensions and Turkey is considered as a developing country, validation of the scale for Turkish culture can bring a contribution to the field. On the other hand, adapted Turkish version of the scale may have a relatively small potential user size. But considering, the measuring model with no background used in the original study and the Technology Acceptance Model (TAM) [22] based measuring model used for the current study, a more important contribution of the study can be perceived.

2. BACKGROUND

Within the studies of human computer interaction (HCI), usability takes an important place [11]. A definition of usability by International Standard Organization is as the degree of accomplishing specified tasks effectively, efficiently and satisfactory [12]. Venkatesh and Ramesh [16] define mobile application usability according to this definition as the degree of using a mobile application to accomplish specified tasks effectively, efficiently and satisfactory. On the other hand, usability for a mobile application mostly associated with using the application easily [3, 23]. For example, Shackel [24] defines usability as the capacity of being used by people easily and effectively. Besides users may tend to use or prefer the applications that are easy to use [2, 3, 7, 23]. But establishing usability for a mobile application is not so easy since the mobile devices have small screens that make inputting relatively hard [6, 8, 25-27]. Using usability scales is suggested to be the easiest way to assessing/establishing the usability [28]. Besides, assessing/establishing the usability for an application is hard without using such scales [1, 7, 29]. Additionally, using some existing scales or instruments may be troubling for non-professionals or novice developers [29]. Systematically developed research scales or instruments may help researchers and developers in that matter [21].

Interface of a software/application has an important part in the usability, for almost all software developers [29-31]. The quality of a software/application is also associated with its usability [15, 32, 33]. Additionally, there may be a relationship between perceived functionality/usefulness of a mobile application and its usability. The users who find a mobile application more usable also find it more functional or at least functional enough [33]. For example, users may find the information on a mobile web site more quality if they like the usability of the site [4, 7, 20]. Claiming the opposite also may not be so wrong. A software/application which provides an effective, efficient and satisfactory functionality within a specified context may be considered to have a high usability [34]. Either way, it indicates a relationship between usability of a mobile application and its actual use [30, 35-45].

Hoehle, Aljafari [21] stated that there are few studies [e.g. 46, 47] that specifically measure mobile application usability. They also stated that most of the instruments that are being used for measuring the mobile application usability [e.g. 9, 28, 45, 48] are adapted from some other studies such as web site usability for desktops. Missing out or ignoring some mobile specific features is possible with the use of such instruments [21, 26]. Hoehle, Aljafari [21] claimed that they developed MAUS leveraging Microsoft's mobile usability guidelines to fill the gap in the field and address the aforementioned issues. They also used two dependent variables along with mobile application usability in a structural measuring model to test

nomological network of the factors of MAUS. These two variables were continued intention to use and brand loyalty. As it is stated in the related literature, continued intention to use is affected by usability [11, 33, 49-51]. People may tend to use the applications that do not require much time and effort to learn and use [7, 11, 52-55]. This tendency may have an important role on their continued intention to use. Usability also have an effect on brand loyalty [56]. It is safe to assume that the ultimate goal of an application is to be used by a significant number of users continuously. Since mobile application usability have a considerable effect on choosing and using a mobile application [11, 57], and based on the aforementioned literature, testing these variables together in a structural model seemed meaningful.

The structural measuring model proposed in this study is based on the TAM [22]. TAM emerged from Theory of Reasoned Action (TRA) [58]. TRA suggests that a person's behavior can be predicted by behavioral intention and behavioral intention can be predicted by attitude and subjective norm. TAM can be considered as a model that adapts this theory specifically to information technologies. The basic components of TAM are Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude towards the use, Behavioral intention, and Behavior. Davis [22] defines PU "the degree to which a person believes that using a particular system would enhance his or her job performance" and PEU as "the degree to which a person believes using a particular system would be free of effort". According to TAM, users' attitudes determine their behavioral intentions and their behavioral intentions determine their actual use of the technology. The model in this study can be thought of as a simplified version of the TAM. The model uses mobile application usability instead of PU and PEU. This change can be considered reasonable when considering the relationship between usability and functionality/usefulness. Brand loyalty take a place as attitude towards the use in the model while continued intention to use represents behavioral intention. The model presented in Figure 1 and the hypotheses presented in Table 1 summarize the relationships that were tested in this study. Accordingly, relationship between the factors of mobile application usability (MAU) and MAU, between MAU and brand loyalty, between MAU and continued intention to use, and between continued intention to use and actual use were tested with the model.

Hoehle, Aljafari [21] suggested to conduct studies that validate generalizability of MAUS to different cultures. An instrument such as MAUS is needed (for the same or similar reasons that stated in the related literature and aforementioned in this study) in Turkish. In addition, it was stated that usability may vary depending on cultural specifications [11, 59-61]. In order to address the need in Turkish and contribute generalizability of the scale this study was conducted. Moreover, Continued intention to use scale (CITUS) and Brand loyalty scale (BLS) (both scales adapted by [21]) were also adapted into Turkish to be used in the model. During this adaptation processes, translation of the scales, confirmatory factor analysis (CFA), and reliability tests were conducted. In addition, following the aforementioned literature, Mobile application Usability, Continued intention to use and Brand loyalty were tested as indicators of Actual use of mobile application within the model (Figure 1). The hypotheses that were tested with the model are given in table 1.

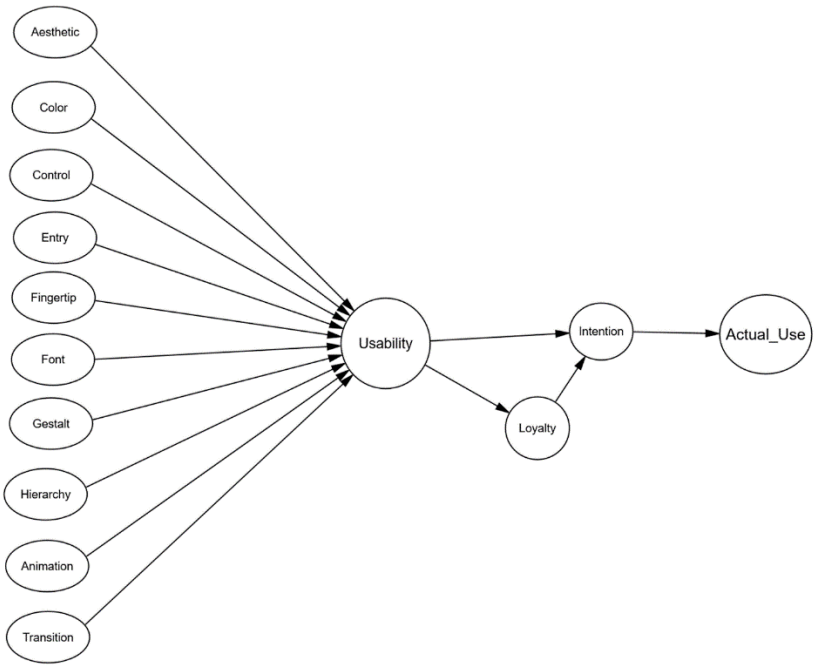

Figure 1. Structural model

Table 1. Tested hypothesis within the structural model

Hypotheses	Effects		
H1	There is a positive relationship between	Continued intention to use	Actual use
H2		Usability Brand loyalty	Continued intention to use
H3			
H4		Usability	Brand loyalty
H5		Aesthetic graphics Color Control obviousness Entry point Fingertip-size controls Font Gestalt Hierarchy Subtle animation Transition	Usability
H6			
H7			
H8			
H9			
H10			
H11			
H12			
H13			
H14			

3. MATERIAL AND METHODS

3.1. Participants

The participants of this study were graduates and undergraduates of a university in eastern Turkey. It was aimed to get responses from 600 students at first. But this number could not be achieved and after evaluation some responses assessed not suitable due to missing fields. The final data set of this study formed by the responses of 476 students. Some demographics of the participants are given in table 2.

Table 2. Some demographics of the participants

Demographic	Category	N=476	%	Demographic	Category	N=476	%
Gender	Male	299	63%	Internet quota from mobile (GB)	1	52	11.4%
	Female	177	37%		2	125	27.3%
Age groups	Under 22	97	20.4%		3	99	21.6%
	22	98	20.6%		4	59	12.9%
	23	113	23.7%		5	33	7.2%
	24 or older	168	35.3%		6 or more	90	19.7%
Faculty	Social sciences	149	31.3%	Access to mobile sites	Application on phone	354	74.4%
	Education	212	44.5%		Web browser	122	25.6%
	Others	115	24.2%	Most used mobile applications	Facebook	118	24.8%
Level	1	43	9.0%		Twitter	23	4.8%
	2	45	9.5%		WhatsApp	172	36.1%
	3	103	21.6%		YouTube	14	2.9%
	4	239	50.2%		Instagram	74	15.5%
	Graduated	46	9.7%		Others	38	7.9%
Smartphone brand	Samsung	206	43.3%	Usage of most used applications (year)	1	38	8.0%
	Apple	72	15.1%		2	78	16.4%
	LG	56	11.8%		3	145	30.5%
	General Mobile	23	4.8%		4	82	17.2%
	Others	119	25.0%		5	48	10.1%
					6 or more	85	17.9%

3.2. Data Collection

Three 7-point Likert scales were used to collect data. The first scale was MAUS which was developed by Hoehle, Aljafari [21]. The scale was formed with 10 constructs/factors which includes four items each (40 items at total, b1-b40 in Figure 2). The second scale was the continued intention to use scale which was adapted by Hoehle, Aljafari [21] from Bhattacherjee [49] and Venkatesh and Goyal [55]. The scale consisted of six items (a1-a6 in Figure 2). The third scale was brand loyalty scale which also adapted by Hoehle, Aljafari [21] from Johnson, Herrmann [56]. The scale consisted of five items (a7-a11 in Figure 2). Adaptation, validity and reliability process of these scales for Turkish are presented in "Findings" section with details.

3.3. Procedure

First of all, the three scales were translated from English to Turkish by a computer science expert who was also good at both languages. Then the original scales and the translations were given as hard copies to five experts to assess the translations. All of the experts have Ph.D. degrees and good at both languages of which two are experts in linguistics, two are experts in psychometry and one is an expert in HCI. Almost all experts gave some slight suggestions which some of them contradicted each other. Therefore it was decided to perform a focus group interview with the experts. The interview took almost 40 minutes and finished with the consensus of the experts on the translations. After the translation process a data collection form including demographic questions was designed for a pilot study which is suggested [62] for testing the measurement instruments. Twenty three students (13 males and 10 females) participated in the pilot study. The participants of the pilot study reported no issues regarding comprehension of the covering letter, understanding of the items or terms, sequence and flow within the form, format (font and lay out) and length of the form. But three of them stated that they were used to fill out 5-point Likert scales and they felt a little strange to fill out a 7-point Likert scale. After consulting with a psychometry expert about this situation it was decided to continue with the 7-point Likert. Thus the data collection form was finalized.

Hoehle, Aljafari [21] conducted their study with the social media application users. Within the current study, a slightly different approach was followed. The final version of the data collection form had two sections. The first section contained demographic questions. The second section contained the three scales but started with two separate questions. Before starting this section the participants were asked to state the name of a mobile application which they used the most. Second they were asked to state how long they have been using this application. Then, they were instructed to give their responses to the items with respect to their most used application. But at the end it did not matter much. As it is presented in table 2, most of the participants stated that they have been using social media applications the most. IBM SPSS Version 23 and AMOS 21.0.0 were used to perform descriptive statistics, correlations, reliability tests and CFA analysis.

4. FINDINGS

4.1. Confirmatory Factor Analysis

CFAs and reliability tests for MAUS, CITUS and BLS were conducted separately. The results are presented in table 3. All items loaded with acceptable values which ranged between 0.33 and 0.97 and supporting convergent validity for all factors of MAUS and for CITUS and BLS as well. Cronbach's alpha reliability coefficients of all factors of MAUS and also for CITUS and BLS were calculated. All reliability coefficients were high and ranged between .74 and .94 for the factors of MAUS. The value was .88 for CITUS and it was also .88 for BLS. But there were some troubling items with low loading values and decreasing Cronbach's alpha coefficient of the factor or scale they belonged. These items were, item 4 of color factor (COL4), item 4 of fingertip-size controls factor (FTSC4), item 3 of subtle animation factor (SANM3), and item 5 of CITUS. The Cronbach's alpha coefficients for these factors/scale if the items were deleted also presented in the table 3.

Table 3. Measurement properties of MAUS, CITUS and BLS

	Mean	**Std.dev.**	**Loading**	**t values**	**CR (>0.70)**	**AVE (>0.50)**	**Cron.α (>0.70)**	**Convergent Validity**
Aesthetic graphics (AEST1-4)					0.94	0.78	0.94	Established
	5.16	1.51	0.75	20.80				
	4.94	1.56	0.91	36.99				
	4.85	1.54	0.96	*				
	4.98	1.46	0.93	42.64				
Color (COL1-4)					0.86	0.62	0.78	Established
	5.25	1.37	0.93	32.73				
	5.22	1.39	0.94	*				
	4.93	1.44	0.78	23.03				
	3.80	2.18	0.36	7.67			0.91**	

Control obviousness (COOB1-4)					0.89	0.67	0.88	Established
	4.91	1.52	0.64	14.01				
	5.25	1.37	0.88	26.38				
	5.29	1.28	0.91	*				
	5.24	1.35	0.87	26.61				
Entry point (ENPO1-4)					0.84	0.58	0.86	Established
	4.82	1.63	0.63	19.41				
	4.70	1.63	0.68					
	5.29	1.49	0.83	13.47				
	5.02	1.57	0.79	13.81				
Fingertip-size controls (FTSC1-4)					0.82	0.56	0.82	Established
	5.02	1.49	0.91	22.40				
	5.07	1.49	0.90	*				
	4.59	1.54	0.66	15.38				
	4.59	1.63	0.45	8.80			0.86**	
Font (FON1-4)					0.94	0.80	0.94	Established
	5.25	1.36	0.92	37.66				
	5.27	1.37	0.94	*				
	5.29	1.36	0.91	34.47				
	5.17	1.44	0.83	25.98				
Gestalt (GEPR1-4)					0.90	0.70	0.91	Established
	4.99	1.38	0.78	17.68				
	5.04	1.37	0.87	22.46				
	5.10	1.31	0.88	25.33				
	4.98	1.38	0.84	*				
Hierarchy (HIER1-4)					0.91	0.71	0.91	Established
	4.93	1.47	0.80	19.55				
	4.93	1.39	0.87	23.61				
	4.96	1.35	0.90	*				
	5.06	1.36	0.85	26.55				
Subtle animation (SANM1-4)					0.81	0.54	0.74	Established
	4.96	1.48	0.87	21.36				
	4.91	1.42	0.89	*				
	3.84	2.20	0.34	7.02			0.86**	
	4.90	1.49	0.71	16.99				
Transition (TRAN1-4)					0.80	0.53	0.83	Established
	4.54	1.72	0.45	11.12				
	4.36	1.77	0.51	*				
	4.84	1.64	0.92	17.65				
	4.87	1.66	0.91	9.03				
CITUS (CINT1-6)					0.90	0.62	0.88	Established
	5.74	1.57	0.87	28.14				
	5.54	1.54	0.89	29.41				
	5.67	1.47	0.93	*				
	5.48	1.60	0.85	28.15				
	4.28	1.75	0.26	5.59			0.93**	
	5.44	1.62	0.77	22.65				
BLS (BLOY1-5)					0.86	0.56	0.88	Established
	3.47	1.98	0.74	14.64				
	4.13	1.87	0.79	17.23				

	5.20	1.52	0.71	15.58				
	4.66	1.83	0.84	*				
	4.12	1.95	0.74	16.88				

* Parameter with fixed value at 1.0 in the original solution.
**Cronbach's alpha if item deleted.

Factor/scale centric discriminant validity for the factors of MAUS, CITUS and BLS were examined. The results revealed significant differences between pairs of the factors and the unity. The results are presented in table 4. All of the correlations between the pairs were significant at the level 0.001. There was only one concern regarding discriminant validity. The square root of the AVE for color factor is less than its correlation with aesthetic graphics factor.

Table 4. Discriminant validity of the factors of MAUS

	CR	AVE	MSV	Max R(H)	Aest.	Col.	Ctrl.	Entry	Fing.	Font	Gest.	Hier.	Ani.	Tran.
Aesthetic	0.93	0.79	0.64	0.96	0.88									
Color	0.85	0.62	0.64	0.94	0.80	0.79								
Control	0.89	0.68	0.39	0.92	0.53	0.62	0.82							
Entry	0.82	0.54	0.44	0.84	0.56	0.54	0.56	0.74						
Fingertip	0.82	0.56	0.44	0.91	0.53	0.50	0.52	0.66	0.75					
Font	0.94	0.81	0.45	0.95	0.53	0.57	0.62	0.54	0.50	0.90				
Gestalt	0.90	0.69	0.52	0.90	0.58	0.62	0.61	0.66	0.59	0.67	0.83			
Hierarchy	0.90	0.71	0.52	0.92	0.45	0.50	0.55	0.56	0.56	0.60	0.72	0.84		
Animation	0.81	0.54	0.40	0.89	0.51	0.49	0.52	0.54	0.49	0.58	0.60	0.63	0.73	
Transition	0.80	0.53	0.28	0.91	0.36	0.42	0.50	0.44	0.42	0.43	0.53	0.51	0.52	0.73

CFA measures of model fit was initially conducted for factor/scale centric fit indexes. Goodness of fit indexes for all the factors of MAUS and for CITUS and BLS were excellent [63, 64]. The factor/scale centric fit indexes are presented in table 5. Thus it was proven that the items were assessing the factors they are belonging well.

Table 5. CFA measures of model fit factor/scale centric

	Adjusted $\chi 2$	Goodness of fit	RMSR
Aesthetic graphics	<3*	1.000	0.001
Color	<3*	0.998	0.020
Control obviousness	<3*	0.999	0.009
Entry point	<3*	0.997	0.018
Fingertip-size controls	<3*	0.999	0.012
Font	<3*	0.999	0.002
Gestalt	<3*	0.997	0.011
Hierarchy	<3*	0.999	0.005
Subtle animation	<3*	0.996	0.056
Transition	<3*	0.997	0.017
Continued intention to use	<3*	0.993	0.037
Brand loyalty	<3*	0.996	0.031

* p>.05

4.2. Testing the Model Hypotheses

Fit indexes of the model were calculated as $\chi 2/df = 2.188$; RMSEA = 0.050; RMSR = 0.165; GFI = 822; NFI = 0.873; CFI = 0.926; RFI = 0.866; and AGFI = 0.805. These values indicated that the model remains within the acceptable limits [63-66]. Path coefficients were examined (at the level .01) to test the structural model and the model hypotheses. Correlation coefficients of the paths within the model were calculated and found to be significant. The results for the proposed structural model and the hypotheses are presented in figure 2 and table 6. Correlation coefficients among constructs of the model indicate statistical confirmation of all the hypotheses. The relationship between Actual use and Continued intention to use (H1: $\beta = 0.72$, $t = 8.63$), between Continued intention to use and Usability (H2: $\beta = 0.43$, $t = 7.14$), between Continued intention to use and Brand loyalty (H3: $\beta = 0.61$, $t = 12.82$), and between Brand loyalty and Usability (H4: $\beta = 0.18$, $t = 3.00$) were statistically significant. The relationship between Actual use and Continued intention to use had the highest value which indicated a high relationship. Then the relationship between Continued intention to use and Brand loyalty, and the one between Continued intention to use and Usability respectively which indicated a moderate relationship. The relationship between Brand loyalty and Usability had the lowest value and indicated a low relationship. Thus with the sample data, Actual use was highly affected by Continued intention to use. Brand loyalty and Usability were the significant determinant of Continued intention to use. The relationships between Usability and 10 factors of MAUS were also significant and almost all of them had high values that indicating high relationships except for Transition factor. The relationship between Usability and Transition had the lowest value and indicated a moderate relationship (H14: $\beta = 0.61$, $t = 11.92$). The results revealed that

Usability were affected by Gestalt the most (H11: $\beta = 0.84$, $t = 15.62$).

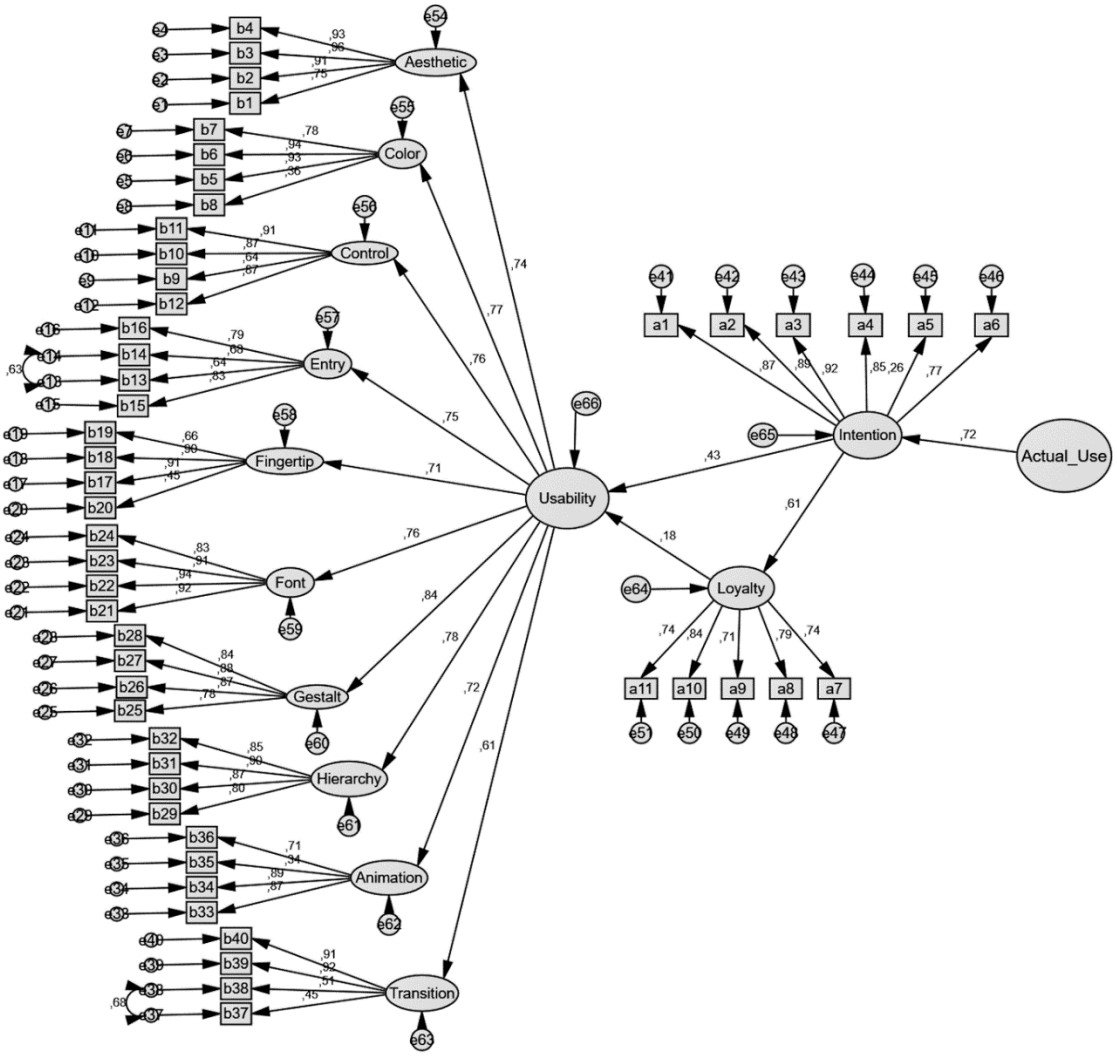

Figure 2. Structural model results

Table 6. The structural model hypotheses results

Hypothesis			Path coefficient	t-value	Remarks
H1	Continued intention to use	Actual use	0.72	8.63	Supported*
H2	Usability	Continued intention to use	0.43	7.14	Supported*
H3	Brand loyalty		0.61	12.82	Supported*
H4	Usability	Brand loyalty	0.18	3.00	Supported*
H5	Aesthetic graphics	Usability	0.74	13.49	Supported*
H6	Color		0.77	15.36	Supported*
H7	Control obviousness		0.76	14.42	Supported*
H8	Entry point		0.75	11.61	Supported*
H9	Fingertip-size controls		0.71	13.78	Supported*
H10	Font		0.76	15.25	Supported*
H11	Gestalt		0.84	15.62	Supported*
H12	Hierarchy		0.78	14.96	Supported*
H13	Subtle animation		0.72	13.46	Supported*
H14	Transition		0.61	11.92	Supported*

* $p<.01$

5. DISCUSSION AND CONCLUSIONS

The aim of the current study was to adapt MAUS [21] to the Turkish culture and test its nomological network. In order to perform an effective adaptation process and test the nomological network of the scale, it was decided to test the adapted scale within a structural model. The model was founded on the assumption that all mobile applications (all products for that matter) are aimed to be used. Therefore actual use of an application may matter the most. Based on aforementioned studies, a simplified TAM was conducted

for this study. Before testing the model, adaptation and assessment of reliabilities and validities of MAUS, CITUS and BLS were performed. Thus adaptation of the three scales into the Turkish culture were accomplished within this study.

First of all, CFAs were conducted to examine measurement properties of the scales. Convergent validity was supported for all the constructs (see table 3). For all the factors of MAUS, CITUS, and BLS all standardized factor loadings were statistically significant and were higher than the threshold of 0.70, which indicate a good validity. The item reliability values were higher than the suggested standard of 0.4 [54], except for COL4, SANM3, and CINTU5, thus indicating item reliabilities were acceptable. The composite reliability (CR) of each the factors of MAUS, CITUS, and BLS were above the threshold of 0.70, ranging from 0.80 to 0.94 for the factors of MAUS and 0.90 for CITUS and 0.86 for BLS which implied that the items are sufficiently representative on their respective construct. The average variances extracted (AVE) were higher than the suggested level of 0.50, ranging from 0.53 to 0.80 for the factors of MAUS and 0.62 for CITUS and 0.56 for BLS. These results suggested a strong relationship between the items and their respected constructs.

Although Cronbach's alpha coefficients of all the factors of MAUS, CITUS and BLS were higher than 0.70 which indicated a good reliability, the items COL4, FTSC4, SANM3, and CINTU5 decreased the reliability of their respected factor/scale. Despite the fact that COL4, SANM3, and CINTU5 also had low loading values, after consulting with an expert of psychometry and another expert of HCI it was decided to keep the items. But in future studies, researchers should consider this situation.

Results for the tested model indicated that the model is an acceptable even a good model with sample data. Responses to the 40 items of MAUS can be explained by 10 factors as in the original study [21]. Also responses to the six items of CITUS and five items of BLS can be explained by the respected scales as well. Almost all of the items has an acceptable loading on their respected factor/scale. There are only two correlations between measurement error terms of the items which is more than acceptable considering the number of items. The relationship between 10 factors of MAUS and Usability is validated. The relationship between Usability, Continued intention to Use, Brand loyalty and Actual use was also validated. Thus Usability and Brand loyalty can be considered as valid predictors of Continued intention to use and Continued intention to use as valid predictor of Actual Use with sample data.

Most of the studies within the scope of HCI or information systems aim to determine why and how users interact with a technology. MAUS, on the other hand, measures the usability of a mobile application and also can be related to continued intention to use of the users. Also, most of those HCI studies has been conducted in a laboratory environment [67]. The current study, on the other hand, was conducted with the participation of real users who responded to the scales with respect to their most used mobile applications. Therefore MAUS can be considered to be a more effective and efficient instrument for collecting mobile application usability data. Also, as it was stated by [21] and confirmed by this study, each factor of MAUS can be used separately so that they can be used within researches that aim to study just one or a few factors of a mobile application [21].

As aforementioned, it was stated that usability may vary depending on cultural specifications [11, 59-61]. It was also stated that usability may vary depending on personal preferences/differences [52, 68-72] or/and personal purposes of use [73, 74]. In line with these statements, for future researches, studying mobile application usability in the contexts that include personal differences such as age, gender etc., usage purposes such as gaming, business etc. is suggested.

Considering continuous increase in the use and development of mobile devices or applications [8, 75], it can be claimed that instruments such as MAUS can contribute effectiveness and efficiency of the researchers and the developers. These contributions can be even more significant, considering investments to the mobile applications in lots of fields including education [2, 5, 10, 75]. MAUS can be helpful both in development process to develop more usable applications and implementation process to evaluate/assess the application that is being used.

APPENDIX A: Turkish versions of the MAUS scale

No	Ölçek maddeleri / Derecelendirme	Kesinlikle Katılmıyorum	Katılmıyorum	Biraz Katılmıyorum	Kararsızım	Biraz Katılıyorum	Katılıyorum	Tamamen Katılıyorum
1	Mobil uygulamada güzel görseller kullanılmıştır.	1	2	3	4	5	6	7
2	Mobil uygulamada ilgi çekici, zengin, güzel ve merak uyandırıcı grafikler kullanılmıştır.	1	2	3	4	5	6	7
3	Mobil uygulamada etkili/çarpıcı grafikler kullanılmıştır.	1	2	3	4	5	6	7
4	Mobil uygulamada güzel ve ilgi çekici grafiklerden yararlanılmıştır.	1	2	3	4	5	6	7
5	Mobil uygulamada uygun renkler kullanılmıştır.	1	2	3	4	5	6	7
6	Mobil uygulamada uygun renklerden yararlanılmıştır.	1	2	3	4	5	6	7
7	Mobil uygulamada çok güzel renkler bulunmaktadır.	1	2	3	4	5	6	7
8	Mobil uygulamada renkler yanlış **kullanılmamıştır**.	1	2	3	4	5	6	7
9	Mobil uygulamada, uygulamanın asıl işlevi hemen görünür/fark edilir yapılmıştır.	1	2	3	4	5	6	7
10	Mobil uygulamada anlaşılması/kullanılması kolay komutlar kullanılmıştır.	1	2	3	4	5	6	7
11	Mobil uygulamada açık/anlaşılır kontroller kullanılmıştır.	1	2	3	4	5	6	7
12	Mobil uygulamada kullanılan kontroller anlaşılması/kullanılması kolay kontrollerdir.	1	2	3	4	5	6	7
13	Mobil uygulamaya iki farklı yolla erişilebilir.	1	2	3	4	5	6	7
14	Mobil uygulamaya iki farklı menü üzerinden erişilebilir.	1	2	3	4	5	6	7
15	Mobil uygulama bir simge veya menü kullanılarak açılabilir.	1	2	3	4	5	6	7
16	Mobil uygulamaya farklı simgeler veya menü erişim noktaları kullanılarak erişilir.	1	2	3	4	5	6	7
17	Mobil uygulamada parmak ucu büyüklüğü kontrolleri kullanılmıştır.	1	2	3	4	5	6	7
18	Mobil uygulamada parmak ucu büyüklüğü butonlarından yararlanılmıştır.	1	2	3	4	5	6	7
19	Mobil uygulamada büyük boy kontroller kullanılmıştır.	1	2	3	4	5	6	7
20	Mobil uygulamada, dokunmadan önce dikkatlice seçmenizi gerektiren küçük kontroller kullanılmıştır.	1	2	3	4	5	6	7
21	Mobil uygulamada iyi bir yazı tipinden (font) yararlanılmıştır.	1	2	3	4	5	6	7
22	Mobil uygulamanın iyi bir yazı tipi (font) vardır.	1	2	3	4	5	6	7
23	Mobil uygulamada iyi bir yazı tipi (font) büyüklüğü kullanılmıştır.	1	2	3	4	5	6	7
24	Mobil uygulamada hoşuma giden bir yazı tipi (font) kullanılmıştır.	1	2	3	4	5	6	7
25	Mobil uygulamada birbiriyle benzeşen bileşenler için benzer şekiller kullanılmıştır.	1	2	3	4	5	6	7
26	Mobil uygulamada benzer bileşenler bir arada gruplandırılmıştır.	1	2	3	4	5	6	7
27	Mobil uygulamada birbirine bağlı (veya bir bütüne ait) şeyler gruplandırılmıştır.	1	2	3	4	5	6	7
28	Mobil uygulamada birbiriyle benzeşen bileşenler için benzer şekillerden yararlanılmıştır.	1	2	3	4	5	6	7
29	Mobil uygulamada iyi tanımlanmış hiyerarşik bir yapı vardır.	1	2	3	4	5	6	7
30	Mobil uygulamada açık/anlaşılır bir hiyerarşi kullanılmıştır.	1	2	3	4	5	6	7
31	Mobil uygulamada, ekranda bir hiyerarşi oluşturmak için başlıklardan yararlanılmıştır.	1	2	3	4	5	6	7
32	Mobil uygulamada bir hiyerarşi sağlanması için başlıklar kullanılmıştır.	1	2	3	4	5	6	7
33	Mobil uygulamada içeriğin aktarılması için animasyonlar etkili bir şekilde kullanılmıştır.	1	2	3	4	5	6	7
34	Mobil uygulamada animasyonlar uygun şekilde kullanılmıştır.	1	2	3	4	5	6	7
35	Mobil uygulamada aşırı/gereksiz animasyon **kullanılmamıştır**.	1	2	3	4	5	6	7
36	Mobil uygulamada içeriğin aktarılması için uygun animasyonlar kullanılmıştır.	1	2	3	4	5	6	7
37	Mobil uygulamada, bir ekrandan başka bir ekrana geçiş yapılırken bilgi verilir.	1	2	3	4	5	6	7
38	Mobil uygulama ne zaman bir ekrandan başka bir ekrana geçileceğini kullanıcıya bildirir.	1	2	3	4	5	6	7
39	Mobil uygulama bir ekrandan başka bir ekrana sorunsuz geçiş yapar.	1	2	3	4	5	6	7
40	Mobil uygulama bir ekrandan bir sonraki ekrana kolayca/pürüzsüz geçiş yapar.	1	2	3	4	5	6	7

APPENDIX B: Turkish versions of the CITUS scale

No	Ölçek maddeleri / Derecelendirme	Kesinlikle Katılmıyorum	Katılmıyorum	Biraz Katılmıyorum	Kararsızım	Biraz Katılıyorum	Katılıyorum	Tamamen Katılıyorum
1	Mobil uygulamayı kullanmaya devam etmeyi düşünüyorum.	1	2	3	4	5	6	7
2	Mobil uygulamayı kullanmayı bırakmak yerine kullanmaya devam etmeyi istiyorum.	1	2	3	4	5	6	7
3	Mobil uygulamayı kullanmaya devam edeceğimi tahmin ediyorum.	1	2	3	4	5	6	7
4	Mobil uygulamayı kullanmaya devam etmeyi planlıyorum.	1	2	3	4	5	6	7
5	Gelecekte mobil uygulamayı kullanmaya devam etmeyi **düşünmüyorum**.	1	2	3	4	5	6	7
6	Gelecekte mobil uygulamayı kullanmaya devam etme ihtimalim yüksektir.	1	2	3	4	5	6	7

APPENDIX C: Turkish versions of the BLS scale

No	Ölçek maddeleri / Derecelendirme	Kesinlikle Katılmıyorum	Katılmıyorum	Biraz Katılmıyorum	Kararsızım	Biraz Katılıyorum	Katılıyorum	Tamamen Katılıyorum
1	Mobil uygulamayı kullanmaları için arkadaşlarımı ve akrabalarımı cesaretlendiririm.	1	2	3	4	5	6	7
2	Başkalarına mobil uygulamayla ilgili olumlu şeyler söylerim.	1	2	3	4	5	6	7
3	Önümüzdeki birkaç yıl, mobil uygulamanın sunduğu daha fazla hizmetten yararlanacağım.	1	2	3	4	5	6	7
4	Görüşümü soran birine mobil uygulamayı tavsiye ederim.	1	2	3	4	5	6	7
5	Mobil uygulamayı ilk tercihim olarak değerlendiririm.	1	2	3	4	5	6	7

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