Evaluation of Mobile Banking Apps in Terms of Usability with Analytical Hierarchy Process

Mobil Bankacılık Uygulamalarının Kullanılabilirlik Açısından Analitik Hiyerarşi Süreci ile Değerlendirilmesi

Mehmet Sinan BAŞAR
Atatürk Üniversitesi Açıköğretim Fakültesi Öğretim Üyesi,
sinanb@atauni.edu.tr

Sinan KUL
Atatürk Üniversitesi İktisadi ve İdari Bilimler Fakültesi Öğretim Üyesi,
sinan.kul@atauni.edu.tr

Bilgi Yönetimi Dergisi

Cilt: 3 Sayı: 1 Yıl: 2020

https://dergipark.org.tr/tr/pub/by

Hakemli Makaleler

Araştırma Makalesi

Makale Bilgisi

Gönderildiği tarih: 21.01.2020
Kabul tarihi: 02.03.2020
Yayınlanma tarihi: 30.06.2020

Article Info

Date submitted: 21.01.2020
Date accepted: 02.03.2020
Date published: 30.06.2020

Keywords

Mobile Banking, Mobile Applications, Analytic Hierarchy Process, Human Computer Interaction, Usability

Anahtar sözcükler

Mobil Bankacılık, Mobil Uygulamalar, Analitik Hiyerarşi Süreci, İnsan Bilgisayar Etkileşimi, Kullanılabilirlik

DOI numarası

10.33721/by.677976

ORCID

0000-0002-6741-6268 (1)

0000-0002-7824-756X (2)

Abstract

Efficiency and satisfaction are three factors that determine the usability of a product or system. To evaluate these factors, it is necessary to separate them into sub-criteria. The availability of the system can also be measured by these sub criteria. In this study, mobile applications of 6 banks in Turkey were evaluated comparatively in terms of usability.

In this study, alternatives and criteria were first determined. Then a team of experts evaluated the criteria comparatively and a comparison matrix between factors was obtained. A comparison matrix between factors was calculated to show the importance of all factors. Then, the mobile applications of the banks were compared among themselves, and this process was performed separately for each evaluation factor.

As a result of the analysis, banks' mobile applications are ranked according to the score they received in terms of usability. In addition, whether banks are state or private had no effect on the availability of mobile applications.

Öz

Etkinlik, verimlilik ve memnuniyet, bir ürünün veya sistemin kullanılabilirliğini belirleyen üç önemli faktördür. Bu faktörleri değerlendirmek için alt kriterlere ayrmak gerekir. Sistemin kullanılabilirliği bu alt kriterler kullanılarak daha net ölçülebilir.

Bu çalışmada, Türkiye'deki üç kamu bankası ile üç özel bankanın mobil uygulamaları kullanılabilirlik açısından karşılaştırmalı olarak değerlendirilmiştir. İlk aşamada, alternatifler ve kriterler belirlenmiştir. Daha sonra kriterler uzman bir ekip tarafından karşılaştırmalı olarak değerlendirilip faktörler arası karşılaştırma matrisi elde edilmiştir. Üçüncü adımda faktörlerin bir bütün olarak önemini gösteren matrisi hesaplanmış, bu işlemde faktörler arası karşılaştırma matrisinden yararlanılmıştır. Bankaların mobil uygulamaları kendi aralarında karşılaştırılmış ve bu süreç her bir değerlendirme faktörü için ayrı ayrı gerçekleştirilmiştir.

Analiz sonucunda bankaların mobil uygulamaları kullanılabilirlik açısından aldıkları puana göre sıralanmıştır. Ayrıca, Bankaların kamu ya da özel olmasının, mobil uygulamaların kullanılabilirliği üzerinde etkisi olmadığı da görülmüştür.

1. Introduction

The development of interactive technologies has created a completely new field of study that combines human sciences and computer engineering. This area, which is called human computer interaction, can

be divided into three main topics: the first one is the design of computer systems according to human needs and behaviors as hardware, software and interface. The second is the study of cognitive and behavioral characteristics such as experience, skills and habits developed by the people using the system, and the third is the continuous transformation of human and system elements in the interaction process.

Interactive computer systems have four main components: user, task, tool/interface, and context. The task refers to all of the work to be done using the computer system. The task component of mobile banking systems consists of the whole mobile banking transactions. The users of the system are the bank customers who download the applications of the banks to their mobile devices and use them actively. There are many components under the tool/interface heading. The components that first come to mind for the mobile banking systems include the following: mobile devices, mobile networks and internet connection, internet banking and mobile banking systems of the banks, hardware, software, database, security systems, standards, procedures, mobile application software, user interface, among others. The last component, context represents all banking transactions that will be done using the mobile application.

Mobile banking is defined as a complex system consisting of many elements. However, it can be defined as a simple system consisting of a mobile device, internet connection and mobile application, for the individual user. The user perceives the mobile application as an interface where commands are given and the results are displayed on the device screen. When evaluating mobile banking apps in terms of ergonomics, the most important elements to be considered are design and usability of the interface.

2. Usability of a System

Usability is defined as a structure that has emerged within the scope of Human Computer Interaction (HCI) and refers to how easy the system is to learn, to use, how well it works and the extent to which users are satisfied when using it. The qualifications includes satisfaction and learnability, and can be summarized as software quality standards (Gould and Lewis 1985 p.300). The usability of a system is measured by its ease of learning, ease of use and functionality. This concept refers to user-oriented design and process quality at the development stage of the system. Although there is a general awareness and a positive perception in software development organizations about usability, the extent to which they are practices is quite low (Coşkan and Durdu 2014 p.55). The most important reason for this is the belief that usability is complex and its implementation requires significant resources (Ji and Yun 2006 p.117).

Usability criteria should be evaluated separately for system developers and users. Developers and designers take into account the internal functioning of the system and the processes in which inputs are converted to outputs, even if they inevitably consider user needs. For this group, the economic use of resources approach is effective.

The use of the system for the user is focused on the interface. The user sends information, requests, or commands as inputs to the system, and focuses on the output itself rather than the stages at which they turn into output. Internal processes are mostly reflected to the user as processing time. In this case, usability can be measured by a successful interface.

2.1 Usability Criteria

There are many studies on usability, ergonomics and user-friendliness or user-oriented interface design. Because these studies look at the subject from different angles and put forward different approaches, we see many different classifications. A few of these, which commonly referenced, are described below.

Aytekin and Yücel (2017 p.62) defined usability criteria as rules that should be followed for more efficient and comfortable use. These criteria are (Pekcan and Oğulata 2008 p.76);

- Functionality,
- Controllability,

- Flexibility,
- Error management,
- User compliance,
- Self-description,
- Consistency,
- Workload
- Learnability.

Nielson has set intuitive usability principles for Human-Computer Interactive User Interface Design under ten headings (Tatar and others 2016 p.400);

- Constantly informing users,
- Using terms that users can understand,
- User control and freedom for retrieving functions,
- Consistency of different situations, words and actions,
- Preventing error tendency,
- Minimizing memory load of users,
- Optimizing the number of steps required for transactions,
- Not including unnecessary information in dialogs,
- Users to understand and learn errors,
- The effectiveness of the help function.

Design guidelines include considerations for a discreet approach to the usability issue. One of the most set of guidelines consist of the following 10 items, prepared by Nielsen:

- Use of simple and natural dialogue,
- Speaking with the user's language,
- Minimizing the memory load,
- Consistency,
- Provide feedback,
- Clearly indicated output and process termination,
- Proposing shortcuts,
- Designing appropriate error messages,
- Prevention of errors,
- Providing assistance and documentation.

Effectiveness, efficiency and satisfaction are three important factors that determine the usability of a product or system. In order to evaluate these factors, they should be divided into sub-criteria. The usability of the system can be measured by observing how well these sub-criteria are met. Usability factors can be divided into sub-criteria according to their characteristics as follows (Park and Lim, 1999 p.379):

Effectiveness: Percentage of users who successfully completed the task, the number of tasks completed in a given time, the number of errors made by the users, the average accuracy of completed tasks, and the success rate of interaction with errors.

Efficiency: Time spent to on a job, jobs completed per unit of time, number of references used for help, time spent using help, physical / mental workload, and learning time.

Satisfaction: A graded measure of user satisfaction, the proportion of users who say they prefer a system over other alternatives, the proportion of positive opinions expressed about the system during the test, and the frequency of complaints.

3. Analytic Hierarchy Process

Finding the best option is a difficult task for decision-makers in cases where the number of criteria and uncertainty is high. In multi-criteria decision-making problems, the process consists of a long chain of sub-processes from defining the problem to defining and evaluating the criteria (Rençber, 2010 p.55). One of the methods frequently used by researchers and decision makers to shorten and facilitate the decision period is the Analytic Hierarchy Process first proposed by Saaty in 1980 (Yerli, 2006 p.61). The reason for the widespread use of AHS is that it is simple and can be easily implemented with open source software (Oğuzlar, 2007 p.122). In addition, the AHP can be used in individual decision-making processes as well as in group decision-making processes (Dağdeviren, 2007 p.791).

When looking at studies where AHP was used, it appears to have been mostly used to support decision making in banking processes. Common areas of analytical hierarchy in banking are; the credit evaluation process (İç and Yurdakul, 2000 p.1), to evaluate the financial performance of banks (Hunjak and Jakovčević, 2001 p.149; Albayrak and Erkut, 2005 p.47), to evaluate loan demands (Atan et al., 2004; Atan and Maden, 2005 p.8; Girginer, 2008 p.132; Organ and Kenger, 2012 p.119), to evaluate risk criteria of credit rating agencies (Çalışkan, 2004 p.53; Akkaya and Demireli, 2010 p.319) and to determine to what extent the quality factors of mobile banking are considered by customers (Seyrek and Akşahin, 2016 p.47).

The analytic hierarchy process is used in businesses in the following areas: strategic management (Yüksek and Akin, 2006 p.253), measuring the level of firm effectiveness (Babic and Plazibat, 1998 p.24), enterprise resource planning software selection (Wei et al., 2005 p.47), project management (Libertore, 1987 p.12; Al-Harbi, 2001), supplier selection (Tam and Tummala, 2001 p.171; Dağdeviren and Eren, 2001 p.41; Kahraman et al., 2003 p. 382; Liu and Hai, 2005 p.308; Şevkli et al., 2008 p.122), purchasing process (Byun, 2001 p.289; Terzi et al., 2006 p.43), appropriate machine selection (Zone-Ching and Chu-Been, 1996 p.253; Ayağ and Özdemir, 2006 p.179; Duran and Aguiloa, 2008 p.1787), manufacturing process management (Wabalickis, 1988 p.175; Beyazid, 2005 p.808), quality management (Armacost et al., 1994 p.72; Ahire and Rana, 1995 p.61; Crowe et al., 1997 p.205; Chin and Chiu, 1999 p.341; Tsaur et al., 2002 p.107) and maintenance method selection.

There are also studies in which AHS method is used together with multiple decision methods such as TOPSIS, SAW, VIKOR and PROMETHEE.

When applying AHS, criteria and alternatives are determined first. Criteria are then sorted according to their severity. Each alternative is compared with all the other alternatives for each criterion and a separate matrix is created for each criterion. It is recommended to use odd numbers from 1 to 9 for the values in these matrices. However, 2, 4, 6, 8 may be used as intermediate values if necessary. If two alternatives are considered equivalent for a given criterion, a value of 1 is entered in the intersection cell of the alternatives. If one of the two alternatives is valuable relative to the other, the intersection cell will have a value of 3, if it has an absolute advantage, the value 9 is entered in the intersection cell. In the next stage, the consistency of the evaluations is calculated. Consistency value is set to be below 10% (Seyrek and Aksahin, 2016 p.49). Finally, the relative importance of the alternatives is multiplied by the criteria weights and a value is determined for each alternative.

4. Materials and Methods

In this study, mobile applications of banks were evaluated comparatively in terms of usability. An expert team carried out the evaluation, and the number of banks to be compared was decided by this team. In order to determine which banks will be evaluated, mobile applications with the highest usage rate were identified. For this purpose, 523 participants were asked about the two most commonly used mobile banking applications. According to the information obtained, the three most frequently used private banks and three state banks were selected. In order to preserve the anonymity of the banks, public (state) banks are coded as S1, S2, S3, private banks are coded as P1, P2, P3.

The purpose of using the Analytic Hierarchy Process (AHP) is to determine the main criteria that can be preferred in mobile banking applications and to list the mobile banking applications according to these criteria. According to the literature review and expert opinions, 40 criteria were selected to be used in comparison of the applications. Later, the binary comparison form prepared for these criteria was presented to academics who are experts in banking/finance, management information systems and graphic design. As a result of the initial evaluation, 13 criteria were excluded from the analysis as they did not yield appropriate results and mobile apps were mutually evaluated by the academician experts using the remaining 27 criteria.

5. Analysis and Evaluation

Analysis of the mobile applications of banks with AHP is a six-step process. In the first step, criteria for evaluation of usability (assessment factors) were determined. Evaluation was made using the 40 factors determined at the beginning.When the coefficients of compatibility of the obtained results were examined, it was seen that the results of 13 criteria were not compatible and the analysis was continued by making dual comparisons with the 27 remaining criteria. These criteria are listed in Table 1 and Table 2.

ID	Criteria
2	M-banking transactions are being loaded in a reasonable time
5	M-banking application provides sufficient security to perform bank transactions
10	M-banking app is easy to learn
12	In the M-banking application, terms that users would not understand were not used
13	Help function is concrete and solution-oriented
14	Help texts are an appropriate length
15	M-banking application does not contain unnecessary objects that cause confusion
16	The memory load of the M-banking application is minimal for the user
17	Operations can be completed within an appropriate number of steps
18	The way M-banking works is suitable for users
19	The way the M-banking application works suits users' mobile device usage habits
20	The M-banking app has easy-to-remember and handy shortcuts
22	M-banking application is appropriate to the user's level of understanding
23	Concepts in M-banking app are not expressed with different situations and words, so they do not cause confusion
26	M-banking app receives and evaluates customer feedback
27	The M-banking app offers convenient multimedia such as graphics and pictures
28	The content of the M-banking transactions is clearly displayed on the screen in terms of criteria such as range, depth and structure
29	The M-banking app provides a navigation that allows users to easily access information
30	The up-down and right-left weights of the display elements are balanced
31	The display elements are arranged symmetrically
33	The height, width and spacing of the display elements are balanced
34	All display elements are selected and placed to form a whole in terms of function and position
35	The height/width ratio of the shapes conforms to accepted standards and commonly used measures
36	The display shows the optimum number of components
38	M-banking application has a customer-oriented dynamic design
39	Operations can be terminated easily
40	Exiting application is easy

Table 1: Variables Used In the Model

ID	Criteria
1	The M-banking app facilitates access to bank transactions
3	The M-banking application is accessible anytime and anywhere
4	M-banking application can be easily adapted to different screen sizes

ID	Criteria
6	The information provided by the M-banking app is accurate
7	The information provided by the M-banking app is up to date
8	M-banking app gives convenient information about bank transactions
9	The M-banking app offers complete information
11	System operating instructions are easily understood
21	Necessary warnings and controls are carried for final transactions that can no longer be modified
24	The M-banking application provides the right responses to customers' requests
25	The M-banking app is sensitive to customer questions
32	The successive elements have successive and complementary functions
37	There are error checks in data entries and commands and they guide the user

Table 2: Variables Extracted From the Model

In the second step, the criteria were evaluated comparatively and the inter-factor comparison matrix (A) was obtained. In Table 3, matrix A is shown in table format.

Criteria	2	5	10	12	13	14	15	16	17	18	19	20	22	23	26	27	28	29	30	31	33	34	35	36	38	39	40
2	1	2	1/3	1/3	3	3	1/2	1/3	1/2	1/5	1/4	2	1/4	1/3	2	3	3	1/4	5	5	5	4	4	4	2	1/2	1/2
5	1/2	1	1/4	1/4	2	3	1/3	1/3	1/3	1/5	1/5	1/2	1/5	1/3	2	3	2	1/4	4	4	5	3	4	3	2	1/2	1/2
10	3	4	1	2	5	6	2	2	3	1/2	1/2	4	1/2	2	5	6	5	1/2	8	7	8	7	7	6	4	3	3
12	3	4	1/2	1	5	6	2	2	2	1/3	1/2	3	1/2	2	4	5	5	1/2	7	7	8	6	7	6	4	3	3
13	1/3	1/2	1/5	1/5	1	2	1/4	1/5	1/4	1/7	1/6	1/3	1/6	1/4	1/2	2	1/2	1/6	3	3	3	2	3	2	1/2	1/3	1/3
14	1/3	1/3	1/6	1/6	1/2	1	1/5	1/5	1/4	1/7	1/7	1/3	1/7	1/5	1/2	1/2	1/2	1/6	3	2	3	2	2	2	1/3	1/4	1/4
15	2	3	1/2	1/2	4	5	1	1/2	2	1/3	1/3	3	1/3	1/2		4	4	1/3	6	6	7	5	6	5	3	2	2
16	3	3	1/2	1/2	5	5	2	1	2	1/3	1/3	3	1/2	2	4	5	4	1/2	7	7	7	6	6	6	4	2	3
17	2	3	1/3	1/2	4	4	1/2	1/2	1	1/4	1/3	2	1/3	1/2	3	4	3	1/3	6	6	6	5	5	5	3	2	2
18	5	5	2	3	7	7	3	3	4	1	2	5	2	3	6	7	6	2	9	9	9	8	8	8	6	4	4
19	4	5	2	2	6	7	3	3	3	1/2	1	5	2	3	6	7	6	2	9	8	9	8	8	7	5	4	4
20	1/2	2	1/4	1/3	3	3	1/3	1/3	1/2	1/5	1/5	1	1/4	1/3	2	3	2	1/4	5	4	5	4	4	3	2	1/2	1/2
22	4	5	2	2	6	7	3	2	3	1/2	1/2	4	1	3	5	6	6	2	8	8	9	7	8	7	5	3	4
23	3	3	1/2	1/2	4	5	2	1/2	2	1/3	1/3	3	1/3	1	4	5	4	1/2	7	6	7	6	6	5	3	2	2
26	1/2	1/2	1/5	1/4	2	2	1/3	1/4	1/3	1/6	1/6	1/2	1/5	1/4	1	2	2	1/5	4	3	4	3	3	3	1/2	1/3	1/3
27	1/3	1/3	1/6	1/5	1/2	2	1/4	1/5	1/4	1/7	1/7	1/3	1/6	1/5	1/2	1	1/2	1/6	3	3	3	2	2	2	1/2	1/4	1/3
28	1/3	1/2	1/5	1/5	2	2	1/4	1/4	1/3	1/6	1/6	1/2	1/6	1/4	1/2	2	1	1/5	3	3	4	3	3	2	1/2	1/3	1/3
29	4	4	2	2	6	6	3	2	3	1/2	1/2	4	1/2	2	5	6	5	1	8	8	8	7	7	7	5	3	3
30	1/5	1/4	1/8	1/7	1/3	1/3	1/6	1/7	1/6	1/9	1/9	1/5	1/8	1/7	1/4	1/3	1/3	1/8	1	1/2	2	1/2	1/2	1/2	1/4	1/6	1/5
31	1/5	1/4	1/7	1/7	1/3	1/2	1/6	1/7	1/6	1/9	1/8	1/4	1/8	1/6	1/3	1/3	1/3	1/8	2	1	2	1/2	1/2	1/2	1/4	1/5	1/5
33	1/5	1/5	1/8	1/8	1/3	1/3	1/7	1/7	1/6	1/9	1/9	1/5	1/9	1/7	1/4	1/3	1/4	1/8	1/2	1/2	1	1/2	1/2	1/3	1/4	1/6	1/6
34	1/4	1/3	1/7	1/6	1/2	1/2	1/5	1/6	1/5	1/8	1/8	1/4	1/7	1/6	1/3	1/2	1/3	1/7	2	2	2	1	2	1/2	1/3	1/5	1/4
35	1/4	1/4	1/7	1/7	1/3	1/2	1/6	1/6	1/5	1/8	1/8	1/4	1/8	1/6	1/3	1/2	1/3	1/7	2	2	2	1/2	1	1/2	1/3	1/5	1/5
36	1/4	1/3	1/6	1/6	1/2	1/2	1/5	1/6	1/5	1/8	1/7	1/3	1/7	1/5	1/3	1/2	1/2	1/7	2	2	3	2	2	1	1/3	1/4	1/4
38	1/2	1/2	1/4	1/4	2	3	1/3	1/4	1/3	1/6	1/5	1/2	1/5	1/3	2	2	2	1/5	4	4	4	3	3	3	1	1/3	1/2
39	2	2	1/3	1/3	3	4	1/2	1/2	1/2	1/4	1/4	2	1/3	1/2	3	4	3	1/3	6	5	6	5	5	4	3	1	2
40	2	2	1/3	1/3	3	4	1/2	1/3	1/2	1/4	1/4	2	1/4	1/2	3	3	3	1/3	5	5	6	4	5	4	2	1/2	1

Table 3: Comparison Factor Matrix

In the third step, first, the inter-factor comparison matrix (A) was used to calculate the matrix (C), which shows the importance of the factors in the whole. Then, the W column vector, called the Priority Vector, which consists of the row averages of the matrix C, is obtained.

In the fourth step, the consistency of the model was checked. For this purpose, firstly, the vector W multiplied the matrix A and the vector D was calculated. Then, for each criterion, the values in the vector D were divided by the corresponding values in the vector W to obtain the vector E. Table 4 shows the W, D and E vector values, respectively.

W	D	E
0.02903	0.830426	28.60606
0.023186	0.65435	28.2217
0.071636	2.122422	29.62772
0.063787	1.890297	29.63468
0.01446	0.401423	27.76094
0.011626	0.320537	27.57089
0.04591	1.342308	29.23754
0.056935	1.682944	29.55887
0.04082	1.189114	29.13064
0.11219	3.282159	29.25541
0.099646	2.940105	29.50554
0.025954	0.737276	28.40727
0.088967	2.634824	29.61579
0.051115	1.503127	29.40701
0.018336	0.512296	27.93861
0.012975	0.358741	27.64771
0.01637	0.454999	27.79458
0.079638	2.361494	29.65271
0.006635	0.186216	28.06764
0.007404	0.206414	27.87875
0.00593	0.168168	28.35798
0.009101	0.252381	27.7308
0.00825	0.228963	27.7515
0.010304	0.284472	27.60689
0.020508	0.576534	28.11275
0.036554	1.05786	28.93938
0.032731	0.94073	28.74104

Table 4: W, D and E Values

The arithmetic mean of the values in Column E was found to be λ=28,58372. The consistency value of the model was calculated as$CI = \frac{\lambda - n}{n-1} = \frac{28{,}58372-27}{26} = 0{,}060912$. For 27 factors, the Random Indicator RI=3,30933. The consistency indicator (CI) value was divided by the random indicator (RI) value and CR=0.018406 value was obtained.

Since the CR value is less than 0.1, the model is found to be consistent.

In the fifth step, the mobile applications of the banks were compared among themselves, and this process was performed separately for each evaluation factor. As an example of these comparisons, the result of the analysis for factor 2 can be seen in Table 5.

Criter2: M-banking transactions are being loaded in a reasonable time.						
Banks	**S1**	**S2**	**S3**	**P1**	**P2**	**P3**
S1	1	1/3	7	3	5	9
S2	3	1	7	3	5	9
S3	1/7	1/7	1	1/5	1/3	3
P1	1/3	1/3	5	1	3	7
P2	1/5	1/5	3	1/3	1	5
P3	1/9	1/9	1/3	1/7	1/5	1

Table 5: Comparison Results for Evaluation Criter2 of Mobile Applications

In the sixth step, the comparative tables were combined by performing similar procedures as in the third step. The obtained 6 rows and 27 column matrix (S) were also multiplied by the priority vector (W) to obtain the column vector showing the percentage significance for each bank's mobile application. The importance of the mobile applications of the banks can be seen in Table 6, sorted from high to low.

Importance Level	**Bank**
25.99%	P2
19.43%	S2
17.85%	P1
16.50%	S3
13.26%	P3
7.36%	S1

Table 6: Importance Level of Mobile Applications

6. Conclusions

In this study, mobile banking applications belonging to six different banks (three of which are state banks and three of which are private banks) are evaluated within the scope of 27 criteria determined in terms of usability, which is an important quality element in mobile applications. Determined alternatives and criteria were analyzed according to Analytic Hierarchy Process. Analytic Hierarchy Process is an approach that compares criteria and determines their importance according to the binary comparison method in order to enable decision making in multi-criteria decision-making problems and to choose between criteria. As a result of the literature review, it was determined that there is no similar study that examines mobile banking applications in terms of usability and uses the criteria used in this study. In the analysis based on expert opinion, binary comparison matrices of alternatives and criteria were calculated, the consistency of the model was tested and the importance of mobile applications was calculated.

When the usability criteria are evaluated mutually, it is determined that the criteria regarding the suitability of the user's mental structure and usage habits are more important than the others are. The technical characteristics of the design related to ergonomics were found to be less important.

The first three criteria with the highest scoring value among the criteria used in the study were 18 (The way M-banking works is suitable for users), 19 (The way the M-banking application works suits users' mobile device usage habits) and 22 (M-banking application is appropriate to the user's level of understanding).

The last three criteria with the highest scoring value among the criteria used in the study were 31 (The display elements are arranged symmetrically), 30 (The up-down and right-left weights of the display elements are balanced) and 33 (The height, width and spacing of the display elements are balanced).

Because of the analyses, it was determined that the application that best meets the usability criteria among alternative mobile banking applications belongs to Bank P2, which has a 25.99% significance level. S2 bank ranked second with 19.43%, P1 ranked third with 17.85%, S3 ranked fourth with 16.50%, P3 ranked fifth with 13.26% and S1 bank ranked last with 7.36%.

Another conclusion to be drawn from the analysis is that whether they belong to the state or private bank has no effect on the usability of mobile apps. As shown in Table 6, the ranking continues as a state bank and a private bank. While the first place was a private bank (P2), the next rankings were; state bank (S2), private bank (P1), state bank (S3), private bank (P3) and state bank (S1).

When Table 6 is analyzed, it can be seen that the biggest difference is between the first and last banks P2 and S1 and the others, while the banks S2, P1 and S3 do not differ greatly. While the difference in importance between the first bank (P2) and the second bank (S2) is 6.56%, the differences between the other banks can be listed as follows; The significance difference between second bank (S2) and third bank (P1) is 1.58% (19.43% -17.85%), The significance difference between third bank (P1) and fourth bank (S3) is 1.35% (17.85% -16.50%), The significance difference between fourth bank (S3) and the fifth bank (P3) is 3.77% (16.50% -13.26%), the difference between the fifth bank (P3) and the last bank (S1) is 5.90% (13.26% - 7.36 %).

Since the consistency analysis results are less than 2%, it can be said that AHP is a suitable model for comparing bank apps, and that the selection of criteria, the selection of the expert team and the selection of the bank apps are done appropriately.

References

Ahire, S.L. ve Rana, D.S. (1995), "Selection of TQM Pilot Projects Using an MCDM Approach", *International Journal of Quality & Reliability Management,* 12(1), 61-81.

Akkaya, G. C. ve Demireli, E. (2010), Analitik Hiyerarşi Süreci ile Kredi Derecelendirme Analizi Üze¬rine Bir Model Önerisi *Ç.Ü. Sosyal Bilimler Ensti¬tüsü Dergisi*, 19(1), 319-335.

Al Harbi, K, M. (2001), Application of AHP in Project Management, *International Journal of Project Management,* 19(1), 19-27.

Albayrak, Y. E. ve Erkut, H. (2005), Banka Performans Değerlendirmede Analitik Hiyerarşi Süreç Yaklaşımı, *İTÜ mühendislik dergisi,* 4(6), 47-58.

Armacost, R.L., Componation, P.J., Mullens, M.A. ve Swart, W.W. (1994), An AHP Framework for Prioritizing Customer Requirements in QFD: An Industrialized Housing Application, *IIE Transactions,* 26(4), 72-79.

Atan, M. ve Maden, U., (2005), Bireysel ve Kurumsal Kredibilitenin Analitik Hiyerarşi Süreci ile Çözümlenmesi, *İstatistik Mezunları Derneği ve Türk İstatistik Derneği, 4. İstatistik Kongresi,* Belek, Antalya, 8-12.

Atan, M., Maden, U. ve Akyıldız, E., (2004), Analitik Hiyerarşi Süreci (AHS) Kullanımı ile Bir Bankada Kredi Taleplerinin Değerlendirilmesi*, İstanbul Teknik Üniversitesi, VIII. Ulusal Finans Sempozyumu,* İstanbul.

Ayağ, Z. ve Özdemir, R.G. (2006), A Fuzzy AHP Approach to Evaluating Machine Tool Alternatives, *Journal of Intelligent Manufacturing,* 17(2), 179-190.

Aytekin A, ve Yücel Y. B., (2017), Bankamatiklerin Arayüz Tasarımlarının Karşılaştırılması, *Avrasya Sosyal ve Ekonomi Araştırmaları Dergisi (ASEAD),* 4(12) 63-92

Babic, Z. ve Plazibat, N. (1998), Ranking of Enterprises Based on Multicriterial Analysis, *International Journal of Production Economics* 56-57, 29-35

Barbarosoğlu, G. ve Yazgaç, T. (1997), An Application of The Analytic Hierarchy Process to The Supplier Selection Problem, *Production and Inventory Management,* 38(1), 14-21.

Bayrakdaroğlu A. ve Ege İ., (2008) Türkiye'deki Bankaların Performansının Analitik Hiyerarşi Süreci İle Değerlendirilmesi Üzerine Bir Model Önerisi, *TÜİK İstatistik Araştırma Sempozyumu*, Ankara, 8-9.

Bertolini, M. ve Bevilacqua, M. (2006), A Combined Goal Programming-AHP Approach to Maintenance Selection Problem, *Reliability Engineering and System Safety,* 91, 839-848.

Beyazid, O. (2005), Use of AHP in Decision-Making For Flexible Manufacturıng Systems, *Journal of Manufacturing Technology Management*, 16(7), 808-819.

Byun, D.H. (2001), The AHP Approach for Selecting an Automobile Purchase Model, *Information and Management*, 38(5), 289-297.

Çalışkan Ö. V., (2004), Kredi Derecelendirme Kuruluşları ve Risk Değerlendirme Kriterleri, *Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 4(1), 53-66.

Chin, K.S., Chiu,S. ve Tummala, V.M.R. (1999), An Evaluation of Success Factors Using AHP To Implement ISO 14001-Based EMS, *International Journal of Quality & Reliability Management,* 16(4), 341-362.

Coskan N. D. ve Durdu, P. O., (2014), Kullanılabilirlik ve Yazılım Yaşam Döngüsü: Türkiye'deki Yazılım Organizasyonlarındaki Durum, UYMS pp. 55-66 pdfs.semanticscholar.org.

Crowe, T.J. ve Noble, J.S., (1997), Multi-Attribute Analysis Of ISO 9000 Registration Using AHP, International Journal of Quality & Reliability Management, 15(2), 205-222.,

Dağdeviren, M. (2007), Bulanık Analitik Hiyerarşi Prosesi ile Personel Seçimi ve bir Uygulama. Gazi Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, 22(4), 791-799.

Dağdeviren, M. ve Eren, T. (2001), Tedarikçi Firma Seçiminde Analitik Hiyerarşi Prosesi ve 01 Hedef Programlama Yöntemlerinin Kullanılması*, Gazi Üni. Mühendislik-Mimarlık Fak. Dergisi,* 16(1-2), 41-52.

Durán, O. ve Aguiloa, J. (2008), Computer-Aided Machine-Tool Selection Based on a Fuzzy AHP Approach, *Expert Systems with Applications,* 34(3), 1787-1794.

Girginer, N. (2008), Ticari Kredi Taleplerinin Değerlendirmesine Çok Kriterli Yaklaşim: Özel ve Devlet Bankasi Karşilaştirmasi, *Muhasebe ve Finansman Dergisi*, 37, 132-141.

Gould, J. D. ve Lewis, C, (1985), *Designing for Usability: Key Principles and What Designers Think, Communications of the ACM*, 28(3), 300-311.

Hunjak, T. ve Jakovčević, D. (2001), AHP Based Model for Bank Performance Evaluation and Rating, *ISAHP Proceedings*, 149-157.

İç, Y. T. ve Yurdakul M. (2000), Analitik Hiyerarşi Süreci (AHS) Yöntemini Kullanan Bir Kredi Değerlendirme Sistemi*, Gazi Üniversitesi, Mühendislik Mimarlık Fakültesi Dergisi*, 15(1), 1–14.

Ji, Y. G., ve Yun, M. H. (2006), Enhancing the Minority Discipline in the IT Industry: A Survey of Usability and User-Centered Design Practice. *International Journal of Human-Computer Interaction*, 20(2), 117-134.

Kahraman, C., Cebeci, U. ve Ulukan, Z. (2003), Multi-Criteria Supplier Selection Using Fuzzy AHP, *Logistics Information Management*, 16(6), 382-394.

Kodali, R., ve Chandra, S. (2001), Analytical Hierarchy Process for Justication of Total Productive Maintenance, *Production Planning & Control*, 12(7), 695-705.

Libertore, M.J. (1987), An Extension of Analytic Hierarchical Process for Industrial R&D Project Selection and Resource Allocation, *IEEE Transactions on Engineering Management*, 34(1), 12-18.

Liu, F.H.F. ve Hai, H.L. (2005), The Voting Analytic Hierarchy Process Method for Selecting Supplier, *International Journal of Production Economics*, 97, 308-317.

Oğuzlar A. (2007), Analitik Hiyerarşi Süreci İle Müşteri Şikâyetlerinin Analizi*, Akdeniz İ.İ.B.F. Dergisi* 14, 122–134.

Organ, A. ve Kenger, M. D. (2012), Bulanık Analitik Hiyerarşi Süreci ve Mortgage Banka Kredisi Seçim Problemine Uygulanması. *Niğde Üniversitesi İİBF Dergisi*, 5(2), 119-135.

Park, K. S. ve Lim C. H., (1999), A Structured Methodology for Comparative Evaluation of User Interface Designs Using Usability Criteria and Measures. *International Journal of Industrial Ergonomics*, 23, 379-389.

Pekcan B. ve Oğulata, S. N., (2008), Yazılım Ergonomisi ve Bir İşletme Yazılımı Üzerine Uygulanması, *Çukurova Üniversitesi Fen Bilimleri Enstitüsü,* 18(2), 76-83.

Rençber, Ö. F., (2010), Büyük Çaplı Projelerde Karar Verme: Analitik Hiyerarşi Süreci Uygulaması, *Gebze Yüksek Teknoloji Enstitüsü/Sosyal Bilimler Enstitüsü,* Kocaeli.

Şevkli, M., Koh, S.C.L., Zaim, S., Demirbag, M. ve Tatoglu, E. (2008), Hybrid Analytical Hierarchy Process Model for Supplier Selection. *Industrial Management & Data Systems*, 108(1), 122-142.

Seyrek, İ. H. ve Akşahin, A. (2016), Mobil Bankacılık Uygulamaları Kalite Faktörlerinin Analitik Hiyerarşi Prosesi İle Karşılaştırılması, *International Review of Economics and Management*, 4(3), 47-61.

Tam, M.C.Y. ve Tummala, V.M.R. (2001), An Application of the AHP in Vendor Selection of a Telecommunications System, *Omega*, 29(2), 171-182.

Tatar, S., Temel, Ş., Aktaş, M. S. ve Kalıpsız, O., (2016), Bankacılık Uygulamalarının İnsan Bilgisayar Etkileşimi Standartları Kullanılarak İyileştirilmesi, *10. Ulusal Yazılım Mühendisliği Sempozyumu,* 400-407.

Terzi, Ü., Hacaloğlu, S.E. ve Aladağ, Z. (2006), Otomobil Satın Alma Problemi İçin Bir Karar Destek Modeli, *İstanbul Ticaret Üni.-Fen Bilimleri Dergis*i, 5(10), 43-49.

Tsaur, S.H. , Chang, T.Y. ve Yen, C.H. (2002), The Evaluation of Airline Service Quality by Fuzzy MCDM, *Tourism Management*, 23, 107-115.

Wabalickis, R.N. (1988), Justification of FMS with the Analytic Hierarchy Process, *Journal of Manufacturing Systems*, 7(3), 175-182.

Wei, C.C., Chien, C.F. ve Wang, M.J., (2005), An AHP-based Approach to ERP System Selection, *International Journal Production Economics*, 96, 47-62.

Yerli, R. (2006), Kamu Çalışanlarını Motive Eden Faktörlerin Analitik Hiyerarşi Prosesi İle Önceliklendirilmesi ve Bir Kamu Kuruluşunda Uygulama. *Gazi Üniversitesi/Fen Bilimleri Enstitüsü,* Ankara.

Yüksek, İ. ve Akın, A. (2006), Analitik Hiyerarşi Proses Yöntemiyle işletmelerde Strateji Belirleme, *Doğuş Üniversitesi Dergisi,* 7(2), 254-268.

Zone-Ching, L. ve Chu-Been, Y. (1996), Evaluation of Machine Selection by the AHP Method, *Journal of Materials Processing Technology*, 57(3), 253-258.