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OLDER ADULTS' SATISFACTION WITH MHEALTH UI DESIGN-BASED CULTURE: A CASE STUDY OF JORDAN

ABSTRACT

The dramatic growth of the older population worldwide has resulted in a renewed need for mobile health applications (mHealth apps). The use of mHealth UI-designed-based culture can be useful in improving the quality of healthcare for elderly users. Therefore, there is a need for a comprehensive examination of the impact of mHealth UI design-based culture on older adult people's satisfaction. This study was conducted to promote older adults' satisfaction with mHealth UI design-based culture in a culturally specific context. We examined the influence of learning, screen, application capabilities, and terminology and application information on older adults' overall satisfaction with mHealth UI. Eighty-five older adults' users from general population in Jordan participated in this study. The results showed different correlation coefficients between these factors. This study paves the way for future research to consider culture in the design of mHealth UI.

1. INTRODUCTION

Recently, the world witnessed a revolution in mobile services for marketing, health services, trading, and social communication (Parasuraman et al., 2017). Additionally, mobile phones are becoming a vital portion in daily life for all categories of users (Parasuraman et al., 2017). For example, statistics showed that the number of mobile phone users in the world is expected to reach 7.1 billion in 2021 and 7.26 billion by 2022 (Radicati, 2014). The main purpose of the mobile interface is to ensure that users' demands are in line with offered services (e.g., health, learning, entertainment, and shopping) (Punchoojit & Hongwarittorrn, 2017).

Mobile health or mHealth is one of the most used technologies in the development of health-care systems, mainly for supervising medication and observing illness, in addition to learning and medical services (Hoque et al., 2014; Nessa et al., 2008; Sharifi et al., 2013). It is defined as a technological tool that uses wireless communication devices, such as mobile phones, mobile devices, patient monitoring devices, and personal digital assistants (PDAs) to enhance public health, particularly the older adults' health. Through mobile health applications services, elderly people can access medical test results, register for or check appointments, and seek medical information and advices (Deng et al., 2014). Despite the rapid development in technologies and mobile devices in the world and due to their important roles in users' lives, there is still a lack of efforts to provide best-design experience to older adults (Al-Razgan & Al-Khalifa, 2017; Sibai et al., 2014). The older adults are not the core target of mobile applications and design innovation technology (Rodríguez et al., 2017). The key issue associated with older adult users' use of mobile applications is that mobile phone systems are not well designed to accommodate older adult users' characteristics and capabilities (Hwangbo et al., 2013). The older adults have their own characteristics and necessities that are totally different from younger users (Ahmed ALsswey et al., 2018). Despite the rapid development in technologies and mobile devices in the world and due to their important roles in users' lives, there is still a lack of efforts to provide best-design experience to elderly people (Al-Razgan & Al-Khalifa, 2017; Sibai, Rizk, & Kronfol, 2014). The key issue associated with elderly users' use of mobile applications is that mobile phone systems are not well designed to accommodate elderly users' characteristics and capabilities (Hwangbo, Yoon, Jin, Han, & Ji, 2013). That is, elderly users are not the main target of design technology and mobile applications (Rodríguez, Fuentes, Herskovic, & Pino, 2017). This is due to that the current design of mHealth technology is for young people. In addition, elderly users have their own characteristics and necessities that are totally different from younger users (Ahmed ALsswey, Bin Umar, & Bervell, 2018).

2. LITERATURE REVIEW

Taylor and Harper (2001) defined culture as a set of components, which includes knowledge, belief, art, morals, law, habits, customs and any other capabilities acquired by individuals. Several studies have been done on cross-cultural user interface design especially in website design and desktop PCs (e.g., Alostath, Almoumen, & Alostath, 2009; Mushtaha & De Troyer, 2007; Tolba & Mourad, 2011). Conclusions of these studies addressing cultural differences of use in designing UIs could improve acceptance, usability and help users to interact in a better way with the interface.

In addition, Browne (2016) addressed that cultural aspects and individual preferences make it difficult to aid or support the current design typology for elderly users. This phenomenon is due to the different ways in which users interact with technologies depending on their cultural and personal preferences (Khaddam & Vanderdonckt, 2014).

Moreover, designing an interface without considering the preferences of the main users would eventually influence their experience, thus influence satisfaction with the technology (Olson, O'Brien, Rogers, & Charness, 2011). As such, many previous studies have argued that the design of mobile UI needs to be engaging, meaningful, usable, easy to use and motivating (Kascak, Rébola, & Sanford, 2014), particularly for elderly users (Chadwick-Dias, McNulty, & Tullis, 2003; Franklin & Myneni, 2018). Studies on the relationship amongst UI components usability and Arabic culture are still in their early stages (Benaida, 2014). This study has attempted to show how usability is influenced by Arab culture and how UI design based-culture can be devised to help elderly Arab users use the interactive mHealth app UI efficiently. Based on these, it can be assumed that designing a culture-based mobile app UI will likely increase elderly users' satisfaction.

There are several different factors to measure and evaluate user interface, one of them is usability which refers to the study of whether interactive technologies, systems or products are effective to use, easy to learn, and agreeable from the user perspective (Rogers, Sharp, & Preece, 2011). Usability issues in the design of UI may influence users' behaviour and emotional response. Nielsen (1994) suggested that usability has several attributes, and it is usually related with five usability attributes: (1) learnability: The system should be easy to learn so that the user can quickly begin using the system from the first time (2) efficiency: The system and resources should be efficient to use and compatible with the users' goals (3) memorability: The system should be easy for a casual user to remember even if the system has not been used after a long period (4) errors: users cause few errors when interacting with the system; (5) satisfaction: The system obtains approval and satisfaction from the user when using the system. (Nielsen 1993). The principal efficiency, meaning that an interface should be designed to successfully assist users to accomplish tasks, solves problems or achieves goals. Moreover, simple procedures are essential for minimizing the time required for users to achieve a goal upon entering the system.

The principles of Arabic culture are special, unique and often unclear and secretive to Westerners cultures. However, the Arabic culture is traditional, whereas the term culture in the context of this study refers to language and culture aspects, with various practices and rules based on Islamic principles and customs. Consequently, everyday words, images symbols or phrases that may be completely suitable and usual in Western countries could be not suitable for Arab people (Alsswey et al., 2018). For example, in many Arab countries, using pictures on a website for alcoholic drinks or girls or women with skimpy clothes or in bikinis on the beach or other places not acceptable, while this image or pictures may be acceptable in Western countries. This means that there is a need for more cultural research into the preferences and perception of users towards localizing technology design based on specific cultures to meet the end users demands and achieve more acceptance and satisfaction for users.

3. MHEALTH APP BASED - ARAB CULTURE

This study developed a mHealth app UI design based-culture for elderly Arab users. The aim of the designed app was to help users interact in a better way with an app to manage their health-related conditions, as well as providing them with common information about general

causes and symptom of public diseases in the Arab world. Figure 1 shows an example of UI screens of the proposed mHealth application.

Figure 1: The proposed mHealth design

The app designed based on cultural guidelines proposed by Alsswey et al. (2018). This study considered some Arabic cultural aspects (i.e. colour, typeface, icons, layout and language) that can be applied in the design and have a usable effect on users' satisfaction and acceptance towards the app design. The Arabic language was applied because it is the most common and used language in the Arab world in order to guarantee the clarity and understandability of displayed information and avoid confusion that maybe faces elderly Arab users who come from various backgrounds that maybe occurs during using the app such as using local terminology.

Also, three colours (blue, green and black) that derived from Arab cultural and Islamic believes were employed to enhance satisfaction of users. This is related to the fact that Arabs are proud of their history, traditions, religion and culture and wish to express that to others by showing the things that symbolize their culture and history such as language and colours. To detail, green colour symbolizes Islam, black considers a specific period in the Islamic era, and blue relates to the colour of the sky and sea. Also, red and yellow colours were used in creating the app UI for atheistic and attraction. Whereas these two colours are frequently employed in several products that target the Arab world for the users' attention and attraction to use them and purchase different goods such as technology, electronics, clothes, cars, etc.

Font size of 12pt used for text and Headings used font size 14pt. Font type "الرقعة"were used in the app UI to show the information. The use of font size and type in this application is for a number of reasons including easiness, common usage among Arab's everyday writings, simplicity, distance from the complexity, and ease of reading and writing (Azmi & Alsaiari, 2010).

Information architecture of app UI was simply designed based on prior research on the Arab culture such as by Hall (1976) and Hofstede (2001). The researchers marked the Arab culture with certain characteristics such as taking less risk, preference of simple use, and avoidance of complexity of systems.

However, Arab users take a higher account for reputation, dignity, shame, honour, and pessimism. Therefore, the app UI design has considered these common Arab icons and symbols. In addition, the direction of Arab writing and reading system is from right to left. As a result, the UI layout was designed from right to left. Finally, a notification system including labels and messages was used in the app UI design to notify the users about the various stages of use and tasks completed through the provision of easier assistance and information on progress in the system's use.

4. RESEARCH MODEL

This study uses four factors, learning, screen, application capabilities, and application terminology and information. Application capabilities and application terminology and information are the two factors related to performance measures which affect a users' attitude

toward the design of the application (Nielsen & Landauer, 1993). Screen is an important factor to support effective use and learning, while learning factor refers to how it easy for users' to accomplish the tasks using user interface from the first time (Nielsen & Landauer, 1993). Satisfaction is also a vital factor in applications success.

Learning

UI is one of the most components that should be considered in learning (Woo, 2009), because it is the point of interaction between user and learning process. Objectives of learning may not be completed if such relationship becomes unsuccessful, even if the learning content was designated and selected well and the user is willing to learn (ChanLin, 2006; Woo, 2009). In addition, an interface which is easy to use and meets the user's skills level is a vital factor in learning because any difficulty in learning how to use the interface makes users worried and discourages users from staying (Zhang & Von Dran, 2000). Mahanti (2009) investigated the relationship between the learning factor and screen design on users' satisfaction, he claimed that easy learning and simple UI design reducing errors of applications usage and increasing users' satisfaction. For this reason, this study considered that elderly Arab users are benefited cultural design of UI in learning context. Hence, this study hypothesizes that:

H_1: The learning of mHealth UI design-based culture will have a significant influence on elderly users' satisfaction with the technology.

Screen

A user interface which delivers properties such as creative and innovative design elements, attractive and aesthetic screen design with nice background graphics or colours and social interaction will provide motivators for users' engagement, enjoyment and promote their satisfaction (Zhang & Von Dran, 2000). This study considered that elderly Arab users are satisfied with attractive, clear and simple cultural design of mHealth UI. Therefore, we hypothesised the following:

H_2: The screen of mHealth UI design-based culture will have a significant influence on elderly users' satisfaction with the technology.

Application capabilities

System response time, error information handling, and command labeling are common design issues (Faghih, Azadehfar, Reza, & Katebi, 2014). Consequently, it is far better to design mobile app capabilities that are meet the users' needs. While every system or application may not meet their demands in term of speed in processing data and reliability of using the application will likely not be successful. This study considered that the capabilities of designed mHealth app will meet the elderly Arab users' needs. Thus:

H_3: The application capabilities of mHealth UI design-based culture will have a significant influence on elderly users' satisfaction with the technology.

Terminology and application information

Terminology and application information plays an important role in the interaction between the users and applications in which end users can involve in the design using their own familiar domain-related terminology to enhance their ability to understand the system functions and use it correctly (Gulliksen & Sandblad, 1995). To meet user demands and satisfaction, the app should have simple screen design, comprehensive contents, accurate terminology, free error application, flexible navigation and high level of interactivity with the application (Rahim, Hamid, Isa, Satar, & Rozaimee, 2013). Therefore, we expect that:

H_4: The terminology and application information of mHealth UI design-based culture will have a significant influence on elderly users' satisfaction with the technology.
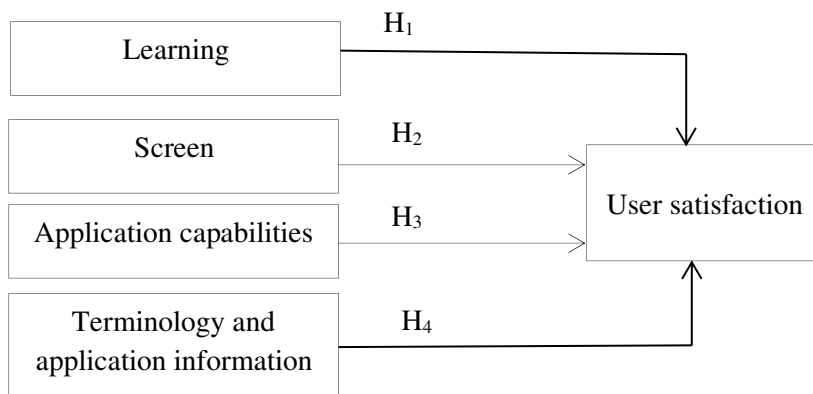
Figure 2. The proposed research model of mHealth UI design-based culture

5. RESEARCH METHODOLOGY

This study used a descriptive approach to examine the effect of the independent factors on the satisfaction of using mHealth app UI for elderly Arab users which is suitable for the type of this study. A questionnaire was designed to collect information about elderly Arab satisfaction with mHealth app UI based–cultural values.

Questionnaire

The questionnaire of this study was adopted from Chin, Diehl, and Norman (1988) using a 9-point scale ranging from 1 to 9 to fit mHealth app UI context. The questionnaire was validated by several previous studies (e.g., Chong, 2013; Gurtner, Reinhardt, & Soyez, 2014; Hoque & Sorwar, 2016). Since the participants were native Arabic speakers and to avoid errors and ensure clarity and accuracy of the responses, two bilingual experts were asked to scan the translated items independently. The questionnaire was divided into two sections. Section A consisted of five questions related to the elderly Arab demographic information. While section B consisted of 21 questions related to the five satisfaction factors namely, terminology and application information, screen, learning, application capabilities and overall application. The participants involved in this study were given an instruction sheet with details about the study and their rights to stop participation at any time and also to access the research results. The analysis was implemented by using SPSS version 22. In addition, ANOVA test was performed to measure inferential statistics between independent and dependent variables. Finally, a multiple linear regression test was applied to determine the relationship between the variables. Reliability test, was conducted to measure the internal consistency of the translated questionnaire. Cronbach's alpha of 0.7 and above was used to test the translated items. The Cronbach's alpha value for all items were larger than 0.70, thus suggesting an acceptable reliability (van Griethuijsen et al., 2015). To improve the validity of questionnaire contents a pilot study has been conducted on in a small portion of the population users experienced in using mobile applications before collecting actual data. Based on their feedback the questionnaire was readable and intelligible.

Participants

The original sample of this study was 100 elderly Arab users from three Arab countries (Jordan, Saudi Arabia, and Iraq) aged 60 years and above and has at least one-year experience in using mobile applications. To guarantee that every participant had met the study criteria purposive sampling approach was employed to collect the sample for this study. One hundred questionnaires were distributed. A total of 85 questionnaires were gathered, which establish 85% response rate for the survey. Among the 85 of questionnaires gathered 4 questionaries were excluded due to incomplete answers for some questions. Only 81 actual questionnaires for data analysis. The demographic information of elderly Arab respondents is shown in Table 1.

Table 1: Demographic information statistics for participants

	Information	Number of participants	Percentage of sample
Age	60-64	65	80.2%
	65-69	10	12.4%
	70-74	4	4.9%
	75-79	2	2.5%
	≥80	0	0%
Participants' Gender	Male	60	74.1
	female	21	25.9%
Participants' Level of Education	School Diploma	26	32.1%
	degree level	23	28.4%
	Bachelor degree	15	18.5%
	Master degree	8	9.9%
	Ph.D. degree	9	11.1%
Participants' experience level of mobile apps use	1-3	15	18.5 %
	4-6	28	32.9%
	7-9	24	29.6 %
	≥10	14	17.3%

Base on Table 1 most of the participants were 60 to 64 years old (84%). 25% of the participants were between 75-79 years old. None of the participants were 80 years or older. With regard to the gender distribution, the majority of participants (n=60, 74.1%) were male and only 21 (25.9%) were female. As for education level, the mainstream of the participants had a school level qualification (n: 26; 32.1%); 9.9% of them had master's certificate; only 9 participants had a Ph.D. degree (11.1%). As for the participants' experience in using mobile applications, majority of them had experience between 4-6 years (32.9%), 24 participants had 7-9 years (29.6%), 15 had 1-3 years of experience, and 14 had 10 years or more of experience (17.3%) in using mobile apps.

6. RESULTS

Correlation analysis

This study employed Pearson's correlation to investigate whether there is a correlation between terminology and app information, screen, mobile app capabilities, learning and overall satisfaction with the design. Pearson's correlation coefficient of $r = 0$: uncorrelated, $r > 0$: positive correlated, and $r < 0$: negatively correlated (Cohen, Cohen, West, & Aiken, 2013). Table 2 shows the correlation analysis results of the satisfaction factors.

Table 2: Pearson correlation coefficients

Factors	Overall (user satisfaction)	Terminology and application information	Screen	Learning	Application capabilities
Overall app	1	.403** .000	.632** .000	.724** .000	.714** .000
Terminology and application information		1	.366** .001	.381** .000	.410** .000
Screen			1	.586 .000	.663 .000
Learning				1	.847** .000

Application capabilities	1

Table 2 shows that the correlation between the satisfaction factors, terminology and app information, screen, mobile app capabilities and learning were significant and positive. Based on the Pearson correlation results, correlation between 1 to 0.3 is considered small; 0.3 to 0.5 is considered medium, and 0.5 to 1.0 is considered large (Field, 2013). The results showed that there is a medium significant correlation between overall satisfaction with the app and terminology and application information ($r = 0.403^{**}$, $p<0.01$). Moreover, the results indicated that there is a large significant correlation between overall app and screen design-based culture ($r = 0.632^{**}$, $p<0.01$). Similarly, the relation between overall satisfaction with the app and application and capabilities was significantly positive and large ($r = 0.714^{**}$, $p <0.01$). Additionally, there is medium significant correlation between the terminology and application information factor and screen ($r = 0.366^{**}$, $p<0.01$), learning ($r = 0.381^{**}$, $p<0.01$), and Application and capabilities ($r = 0.410^{**}$, $p<0.01$). The result also shows there is a large significant correlation between screen and learning ($r = 0.586^{**}$, $p<0.01$). Likewise, there is a large significant correlation between screen and application and capabilities ($r = 0.663^{**}$, $p<0.01$). In addition, the relationship between learning and application and capabilities of mHealth app UI was significantly positive and large ($r = 0.847^{**}$, $p<0.01$).

Factors affecting elderly users' satisfaction to use mHealth UI design-based culture

In order to investigate how mHealth UI-based culture may influence elderly users; satisfaction, a multiple regression analysis was applied. The suitability of the regression was evaluated to assure that there is no violation of the assumptions of normality, outliers, and multicollinearity. All responses were found to be normally distributed and no extreme outliers were detected. As for the multicollinearity test, according to Kock (2016), the variance inflation factor (VIF) was used in this study. VIF values below 3.0 indicate no multicollinearity issue. Based on Table 3, all the VIF values for the variables were ranged between 1.381 to 2.741, below the 3.0 threshold (Kock, 2016).

Table 3: Multicollinearity statistics

Multicollinearity Coefficient	
Factors	VIF
Overall satisfaction	1.621
Terminology and application information	2.386
Screen	2.741
Learning	1.381
Application capabilities	1.697

A stepwise multiple regression was conducted between the dependent and independent variables, to check which of these factors had a significance effect on users' satisfaction with mHealth UI. In addition, it attempts to identify which of these factors were the most important to users' satisfaction. The results of the stepwise regression are presented in Tables 4 and 5.

Table 4 shows the regression coefficients values of four regression models (model 1: terminology and application information on overall app; model 2: screen on overall app; model 3: learning on overall app; model 4: application capabilities on overall app). The results showed that four independent constructs were appeared to be the positive predictors of elderly people's satisfaction with mHealth UI design-based culture.

Table 4: Results of the multiple linear regression analysis

Models	Unstandardized Coefficients		Standardized Coefficients	t	sig
	B	Std.Error	Beta		
Model1					
Terminology and application information →Overall satisfaction	0.311	0.141	0.279	2.642	0.020
Model2					
Screen →Overall satisfaction	0.317	0.065	0.327	6.538	0.000
Model3					
Learning → Overall satisfaction	0.539	0. 081	0. 724	9.339	0.000
Model 4					
Application capabilities →Overall satisfaction	0.309	0.095	0.222	5.062	0.010

The satisfaction of elderly Arab users was found to be associated with the used terminology and information ($\beta = 0.311$, $p < 0.05$), learning ($\beta = 0.539$, $p < 0.05$), screen ($\beta = 0.317$, $p < 0.05$) and application capabilities ($\beta = 0.309$, $p < 0.05$). Learning was found to be the strongest predictor of elderly users' satisfaction with mHealth UI design-based culture.

Table 5. ANOVA results between satisfaction factors

	Model	R	R Squares	Adjusted Square	df	F
1.	Learning →Overall satisfaction	.724[a]	.525	.519	1 79 80	87.219
2.	Learning →Overall satisfaction	.768[b]	.590	.580	2 78 80	56.229
	Screen → Overall satisfaction					

Table 5 shows the ANOVA results between satisfaction factors, the R values, R square values, adjusted R square values and std. error of the estimates for each satisfaction model. The adjusted R^2 of 0.580 for screen and learning factor was statistically significant. Therefore, approximately 58.0% of the variance in the mHealth app UI usage can be explained by the screen and learning factor. The analysis also reveals that learning (β: .539, $p < .05$) significantly contributes 52.5% (r: .724) variance in overall application (F (1,79) = 87.219, $p < .05$). A combination of learning (β: .539) and screen (β: .317) contributes 59.0 % (r: .768) variance in overall satisfaction (F (2, 78) = 56.229, p, <.05).

7. DISCUSSION

Elderly users' satisfaction with mHealth UI design-based culture was investigated. The results indicated that the users were satisfied with the usability of the mHealth app UI. Moreover, the integration of culture in the design of UI for mHealth application can increase users' abilities to manage their medical and learning health information, thus increasing their satisfaction with the app. The results of this study showed that all constructs namely, terminology and application information, screen, learning and application capabilities had a significant influence on elderly users' satisfaction with the mHealth UI design-based culture.

The terminology and application information of mHealth UI design-based culture had a moderate significant relationship with overall mHealth UI satisfaction. This finding shows that the elderly Arab users were satisfied with the terminology and application information displayed in the mHealth app UI probably because UI design uses correct, suitable and consistent information. Moreover, the users were possibly satisfied with this application because it does not contain any

duplicate information or screens. These result is consistent with Moradi-abadi and Jafari (2017) study that found error-free information affects information quality and user satisfaction as well as the quality of the system, service and information is positively reflected in user satisfaction.

Moreover, the screen of mHealth UI design-based culture had large significant positive relationship with overall mHealth app UI satisfaction. This result suggests that the elderly Arab users are satisfied with the simple interface design of the application. The design of the button is suitable for elderly users because the screen is large and the font is easy to read. The colour of the text is also contrasted with the background, which makes the reading process smooth. In addition, the use of common icons to avoid user confusion might have influenced their decision towards satisfaction level of using this mHealth app.

Also, learning of mHealth UI design-based culture had large significant relationship with users' overall mHealth UI satisfaction. This finding indicates that the elderly Arab users were very satisfied with the design of mHealth. This can be reasoned to that the majority of participants had 4–9 years of experience in using mobile applications, which might have influenced their decision to use or continue with this mHealth app. Therefore, it will affect their level of satisfaction with overall mobile learning experiences. In addition, the high levels of satisfaction with the mHealth app might be due to the high quality of their interaction and the application as long as they are comfortable interacting with the culture-based UI design. Whereas in the interaction environment, the users were able to add, edit and delete their medical information, and explore health information, which can enhance their health knowledge and medicine management. This finding is supported by Giannousi, Vernadakis, Derri, Michalopoulos, and Kioumourtzoglou (2009), who found that user satisfaction was higher than average, demonstrating that the users are very satisfied with the overall learning experience.

Finally, application capabilities of mHealth UI design-based culture had large significant relationship with the overall mHealth UI satisfaction. This finding indicates that the elderly Arab users were highly satisfied with using the mHealth app UI possibly because they were able to complete their task efficiently by using the UI components and functions. Given that the mHealth app is error-free in operating and processing the data, and has achieved user demands in terms of speed and reliability, they are satisfied with the application trust and speed in processing their data. This result support by finding the literature posted that mHealth app performance effects user satisfaction (Monney, Penzenstadler, Dupraz, Etter, & Khazaal, 2015; Yasini & Marchand, 2015).

8. CONCLUSION AND FUTURE WORKS

Elderly users' satisfaction with mHealth application UI design-based culture was examined in this study. The satisfaction results of 81 participants showed a great potential of using culture in the design of mHealth applications. It can be concluded that embedding culture in UI design can solve issues and barriers related to the technology use by facilitating users' use of technology. The deigned mHealth application based on Arabic culture values had a positive influence on users; level of satisfaction. This concludes that, involving culture in UI design, simple design, rich and clear health contents, fast information processing, and ease of use were the main factors for increasing users' satisfaction with technology.

Despite these findings, this study poses some limitations that should be highlighted. The current study was limited to elderly Arab users. In addition, the study investigated satisfaction of users in certain Arab countries. Based on limitations, future research needs more empirical research study to be steered for different categories of users and investigate in depth Arab cultural aspects such as colour, language and icons. The preliminary results of this study encourage the researchers for more comprehensive study about the satisfaction, acceptance and adoption of mHealth design-based culture.

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