

# A technology acceptance model for a user-centred culturally-aware e-Health design

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## Abstract

This study builds on previous research, where a technology acceptance model for electronic health (e-HTAM) was investigated, developed and evaluated. The e-HTAM questionnaire originally used showed some weakness in terms of its overall reliability, which highlighted the need for a second phase of study to address the shortfalls reported by the first model. The second phase of the study was conducted after the questionnaire used in the initial phase was modified.

The results suggested that when creating e-Health websites or services, the principle of how e-Health websites and services should be designed and delivered, and under which cultural setting they will be used, should be taken into consideration from the initial design stage.

**Keywords—** Technology acceptance, e-Health, Cultural dimensions, Technology design.

## 1. INTRODUCTION

Previous research into technology acceptance and internet-based applications usage has not been completely successful in establishing what effects culture might have. Most new technologies have originated within a developed cultural context, namely the United States and Western Europe. Consequently, when new technology transfers to different cultural settings we can predict some sort of cultural gap because of their technology design. Most studies have focused on technology transfer into developed countries with a presumption about the fit of that technology, without taking into consideration cultural and social values that would impact its ultimate uptake and acceptance. Few of these studies have tried to investigate how Arab cultural values could influence general acceptance and use of e-Health web-based tools and services. Previous studies [2, 7] suggested that TAM has a slightly better predictive power than other models. TAM was also selected because it is a widely accepted, practical and robust model of technology acceptance covering different issues that can explain technology adoption. However, it lacks the integration of the influence of wider cultural factors such as those of Hofstede [3, 9].

One of this study's aims is to contribute to the building of a model that can be used to develop a culturally sensitive e-Health services acceptance model within an e-Health context. The study reports on the development of this model and offers recommendations for expanding the adoption of e-Health services. The systematic research model produced by this study can be a useful point of departure for further related work in this area.

The research reported here builds on an earlier study where a technology acceptance model for electronic health was developed 'e-HTAM' [1] using a questionnaire approach. This second study reports on the questionnaire's enhancement and the empirical validation of the results.

The e-HTAM results from the first study indicated that Perceived Ease of Use (PEU) ( $r = .438$ ), Perceived Usefulness (PU) ( $r = .420$ ), Trust ( $r = 0.403$ ), and Tangibility (Tang) ( $r = 0.407$ ) are all significantly correlated with Intention to use (I2U). These correlations suggest that PEU, PU, Trust and Tangibility have an influence on the sample population's intention to use e-Health services. Other variables, however, such as Power Distance (PD) and Masculinity (MAS) showed a negative but non-significant relationship with I2U, which suggested that the direct compliance impact of PD and Masculinity on I2U did not work with this particular sample. These original results were sufficiently encouraging to suggest that further work should be done on improving the e-HTAM questionnaire.

Taking account of the findings from the first study [1] resulted in a modified instrument which took into account issues from the first study, such as the language used, internet connection/reliability and availability, the wording of the questionnaires, and the relevance of some questions to the study objectives.

### 1. e-HTAM-2

The initial proposition for e-HTAM was to investigate and assess the significance of integrating cultural dimensions into technology acceptance in the health informatics domain [1,2].

In order to enhance the reliability and validity of e-HTAM [1] the survey that was used in the initial study was improved by first being subjected to revision from professionals in the field. The final set of approved questions was then translated to Arabic language by a professor in linguistics. The hypothesis remained the same as in the first study.

In order to test the proposed model empirically, a pilot study was conducted in the UAE and in the UK<sup>1</sup>. The data were collected based on opportunity sampling through the online questionnaire facility 'questback.com'. 150 people were asked to participate in the UAE of whom 102 responded. 150 people were asked to participate in the UK of whom 127 responded. This represented a response rate of 68% and 85% respectively which is generally accepted as good to very good

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(Nulty, 2008). All the following results refer to the total number of participants regardless of country of residence, giving an overall N of 129.

A Cronbach alpha test ( $\alpha$ ) was performed to test the stability and consistency of the instrument. According to Pallant [5] a good reliability test should produce at least a coefficient value of above 0.70. The reliability of the proposed model constructs was assessed and reported an alpha reading of 0.793, which was considered as acceptable level of internal consistency.

Table 1: Cronbach alpha if item deleted

| Dimensions                      | $\alpha$ if Item deleted |
|---------------------------------|--------------------------|
| Intention to use e-Health (i2U) | .750                     |
| Masculinity/Feminism (MAS)      | .778                     |
| Power Distance (PD)             | .790                     |
| Perceived ease of use (PEU)     | .771                     |
| Perceived Usefulness (PU)       | .740                     |
| Subjective norms                | .778                     |
| <b>Tangibility</b>              | <b>.803</b>              |
| Technology Design               | .752                     |
| Trust                           | .788                     |
| Uncertainty Avoidance           | .766                     |
| Collectivism/individualism      | .775                     |

Although the results of the e-HTAM questionnaire scored overall  $\alpha$  of .793, however, values above .8 are preferred. Inspecting the Cronbach alpha test in Table 1 indicates that there is a possibility of enhancing the Cronbach alpha score. The Tangibility correlation reported  $r = .054$ . As tangibility has no significant correlation with intention to use e-Health, the authors opted to remove this item from the scale. Removing Tangibility from the scale increased the overall  $\alpha$  value to .803 which is considered to be a very good score [5]. It also was a considerable improvement on the original version of the questionnaire used in study 1 in which the alpha score was only 0.651.

## 2. RESULTS ANALYSIS AND DISCUSSION

Each of the dimensions were measured through two to four statements using a Likert type scale where 5 = strongly agree and 1 = strongly disagree. Thus any mean score over 3 would indicate a positive response and under 3 would indicate a negative response. The effect of these dimensions on the intention to use variable will now be presented in turn. The results relating to Perceived ease of use [PEU] indicate that users are in favor of sites that allow them to easily find information they are seeking [PEU 1: *I prefer e-Health websites that are easy to navigate*], the M value was 3.99 and SD was .91. This was supported by the second statement where the participants indicated that they were willing to revisit sites that are easy to navigate although there was a greater variation in the responses as indicated by the high standard deviation [PEU 2: *I prefer e-Health websites that are fun and enjoyable to use*] where the M was 4.02 and SD was 1.06.

These findings suggest that e-Health websites need to be perceived as easy to use, as the majority of respondents (78%) strongly agreed that they prefer websites that are designed in a way that makes the information easy to navigate, compared to 6.6% who think that the ease of use will not motivate them to use e-health services. e-Health websites that are considered enjoyable and fun to use also seems to be an important consideration as 76% of the participants agreed with this second statement.

When it came to examining the effects of perceived usefulness [PU], the results indicated that users would be inclined to visit websites that provide relevant and authentic health information, [PU 1: *I prefer to use e-Health websites that provides detailed information about the disease which I enquire about, rather than general information*] where M was 4.21 and SD was .778.

The participants seemed to be flexible about the provision of services by alternative means such as videos, audio, and images, which suggest that a face-to-face health service is not a concern if the nature of the enquiry is to access information [PU 2: *I prefer the use of multimedia (voice, image, video) to learn about disease or other health issues than visiting the clinic*], where M was =3.43 and SD was .996.

They also perceived that websites which provide health information saved them time and effort. [PU 3: *Accessing medical or health services via the Internet helps me save time and effort*] where M was 3.72 and SD was .96.

The participants seemed to prefer health websites that are interactive, as these websites allowed them to control the interface personalisation [PU 4: *I prefer to use e-Health websites that enable me to control the way the information is displayed and be able to personalize it to suit me*] where M was 3.79 and SD was .8

This implies that users want to have their identities represented or matched by the interface; personalization to some extent allows them to do that. These results suggest that e-Health website acceptance also depends on the content design and interface functionalities.

Other results suggested that participants have a positive attitude towards e-Health services, as they were positive to [I2U 1: *I intend to use the internet to book my medical appointment, if such service is available*], where M was 3.74 and SD was 1.17. The majority 67.68% have a positive intention to use e-Health 'web-based' services, compared to 17.47% who were not keen to use the services. Their positive intention was also supported by their responses to the second item [I2U 2: *I intend to use the internet to obtain health information*], as the M was 4.04 and SD was .943.

These results are in line with previous studies in the technology acceptance field [4, 6]. Based on this it can be argued that users' acceptance of e-Health services could be predicted by their behavioral intentions which could in turn be enhanced by participants' perceptions of ease of use and usefulness.

The results also suggested that participants have a negative attitude towards un-known or new e-Health websites, as [UA 1: *I prefer to visit well known and trusted e-Health websites*] generated an M of 3.99 and SD of .97, where the majority 78% stated they preferred well known and trusted e-Health websites compared to 7.9% who were more likely to be able to deal with uncertainties tolerably.

This particular finding was further supported by participants' preference for using e-Health websites that they visited before [UA 2: *I prefer to visit an e-Health website that I have previously visited*], where M was 3.75 and SD was .920. The majority (72.49%) were of a high uncertainty avoidance classification as they prefer to visit e-Health websites that they have visited before, compared to 10.48% who again were more likely to tolerate uncertainty.

Unpredictable situations may limit people's behavioral intention or 'tolerance' to use new services; for example, the UA variable could be mapped to the Trust factor, as the majority of the participants preferred to use trusted e-Health websites. This suggests that new e-Health systems will be perceived as a 'risk' for users, which indicates that high UA could negatively affect the acceptance of new e-Health systems, which suggest that contents quality, navigation-ability, responsiveness and appropriate language are significant design factors that should be considered to minimize the negative impact of UA when it comes to e-Health system design.

The next dimension refers to the gender role, where a traditional masculine culture is seen to be more assertive and competitive, while a traditional feminine culture tends to be more emotional and caring [4, 8]. The results of the study suggested that participants were more of a feminine culture, as [Mascul 1: *I prefer e-Health websites that are societal and focus on mutual relationships*] generated an M of 3.20 and SD of 1.07, where 41.4% indicated that participants preferred e-Health websites that are colorful and more friendly, focused on people and the role of technology to support social communication, and which do not differentiate between gender in their interface design 'blurring the role of gender'. This was compared to 24.01% who are more of a masculine culture, which suggests that for these participants, they prefer e-Health websites that are technically focused, and equipped with functionalities that help them to perform the tasks quicker.

This was further supported by the low measure of agreement to the second statement [Mascul 2: *I prefer to use non-emotional e-Health websites*] where M was 2.51 and the SD was 1.029. The majority (54.15%) of participants indicated that they did prefer emotionally orientated websites, compared to 14.5% who preferred to use assertive e-Health websites that focus on performance.

The collectivism/individualism dimension refers to the degree people are integrated into groups [3, 8]. The results (M= 3.91, SD=.884) suggest that participants are more collectivist in nature than individual when it comes to their health [Col 1: *I prefer e-Health websites that enable me to communicate with others to discuss my health concerns*]. The majority 72.92% indicated that they prefer to share and learn from others' health experience, and do not feel threatened by exposing their health related issues to the wider e-Health community, as they perceive the benefits of learning from other's health experience is of great value, compared to 7% who are more individualism oriented, where they prefer not to discuss or share their health issues with others.

The Power Distance dimension measured the extent of how much information the participant would like to read about their symptoms. The majority (54.58%) indicated that they would like to read as much as available about their related symptoms, compared to 26.2% who indicated that they were

only interested in the minimum information

The statistics (M = 2.48, SD=1.3) indicate that the majority disagreed with the statement [PD 1: *I prefer to read the minimum information about the disease I enquire about*], they do not believe that someone should limit their access to health information. This indicates that e-health should be able to cater for both categories of users in order to make the service more appealing and acceptable.

The technology design dimension was described as the capability of the interface to be interactive, personalisable, complex, and provide accurate information.

The interface complex functions requirement was measured through [TechDes 1: *I prefer to use e-Health websites that have complex interface functionalities*], where the M was 3.10 and SD was 1.04. The data were distributed equally to some extent as 35% of the participants were of neutral opinions, while 28% indicated that they preferred an uncomplicated interface, compared to 37% who preferred to have a complex interface. These diverse opinions suggest that interface design should be carefully taken into consideration, as designing the interface functionalities without considering potential users' preferences may negatively affect the adoption rate.

Trust investigates the respondents' trust in using the internet as a service channel. The majority of the respondents were undecided (M= 2.85, SD=1.1) when they were asked to respond to the statement that "*The Internet is safe and I do not fear someone might misuse my personal/financial information*", 33.2% of the participants were hesitant to trust internet safety, while 28.4% were willing to provide their personal and financial information online. 38.4% of the participants did not believe that the Internet is safe and they were worried that their financial and personal data could be misused.

The majority of the respondents were neutral or 'undecided' (M= 2.97, SD=1.11) when they were asked about the trustworthiness of internet health information "*The contents of the website are relevant and credible*", 34.5% of the participants were hesitant to trust internet health information, while 34.1% did not trust internet health information compared to 34.4% who believed internet health information is credible and can be trusted, and hence it is perceived as useful.

Such findings about internet safety are common issues for web surfers so e-Health service designers should take necessary measures to deal with this 'threat'. They should only ask for personal or financial information if it is crucial to the task that the user wants to perform online. The contents that are displayed to the users should be relevant to the user's query. e-Health 'web-based' services tend to be intangible. Providing images, animations and clips of the professional in the field may help address tangibility and credibility issues, which also could impact positively on e-Health acceptance.

Subjective norms (SN) refer to the influence of others on one's behavioural intention. Venkatesh and Bala [6] argued that SN significantly influences a person's behaviour if the behaviour in question is of a mandatory nature. About a third of the respondents were neutral or 'undecided' 31.9%, while 28.8% did not agree that others influenced their behavioral intentions to use online health services compared to 39.3.8% who agreed. This statement "*People who influence my behaviour think I should use online health services*" obtained

M= 3.12, and SD=1.1.

The results indicated quite an even split which might be explained by the fact that the subjective norms are affected by where people live. In so called collectivism cultures, for example, such people perceive a higher social pressure to follow their seniors or people who are important to them. An implication of this finding is that for people who are from a collectivism culture, one way of promoting e-health services is through places where they live, work or study together; as friends, colleagues or family members are expected to have social influence on using technology.

Following the descriptive statistics, a further analysis was carried out using Pearson's product-moment correlation coefficient to explore any relationships between each of the dimensions and intention to use (see Table 2)

Table 2: Correlations

| Pearson correlation (2-tailed) |                           |                            |
|--------------------------------|---------------------------|----------------------------|
| Perceived ease of use          | Intention to use e-Health | .406 <sup>**</sup> (.000)  |
| Perceived usefulness           |                           | .519 <sup>**</sup> (.000)  |
| Technology Design              |                           | .392 <sup>**</sup> (.000)  |
| Uncertainty Avoidance          |                           | .385 <sup>**</sup> (.000)  |
| Collectivism/Individualism     |                           | .195 <sup>**</sup> (.003)  |
| Power Distance                 |                           | -.188 <sup>**</sup> (.004) |
| Masculinity                    |                           | .117 <sup>(.078)</sup>     |
| Trust                          |                           | .282 <sup>**</sup> (.000)  |
| Subjective Norms               |                           | .176 <sup>**</sup> (.008)  |

Perceived usefulness was found to be significantly correlated to I2U e-Health services ( $r = .406$ ). This correlation suggests that those users who believe using e-Health websites should be hassle-free, without any undue cognitive stress also score higher on intention to use.. The single largest correlation was, however, between perceived usefulness and their intention to use e-Health services, hence perceived usefulness should be a key design requirement as it appears to be a key factor in forming the acceptance of e-Health services. The implications from these two highly significant correlations are that in order for e-health services to be perceived as useful, they need to appeal to the users; users normally look for cues to reduce the cognitive load. The use of images, videos, enough information, and interface personalization-ability is also likely to positively impact the adoption rate of e-health services.

The results indicates that PEU is significantly correlated with intention to use e-health services ( $r = .406$ ,  $p = .000$ ), which suggest that Perceived Ease of Use is negatively correlated to freedom from effort, which is in line with TAM results [4,6]. The more users feel anxious and have to put effort into using e-Health the less likely they are to accept it. These findings indicated that the participants prefer systems that are easy to navigate through, which is to some extent associated with Uncertainty avoidance which also correlated with intention to use ( $r = 0.385$ ,  $p = .000$ ), as if the system is not easy to navigate through, and the users could not understand the way tasks could performed, they would feel lost, e-Health systems should be designed in a way that they are perceived as easy, enjoyable and fun to use in order to increase the intention to use them.

Technology design significantly correlated ( $r = .392$ ,  $p = .000$ ) with intention to use e-Health services. This correlation suggests that developing a well-informed, usable, easy to navigate; personalisable interface design will lead to increased intention to use e-Health services. There is a need for a balanced interface, and reasonable amount of functions which e-Health interfaces should make visible.

Participants' responses to the questionnaire confirmed the above, as in the survey they were asked [TechDes 1: I prefer to use e-Health websites that have complex interface functionalities], the results indicated hesitant users, as 28% of the participants disagreed, while 35% were neutral compared to 37% who agreed. Balanced interfaces that hide the complex functionalities, and only make them available on user's request are therefore more likely to increase the acceptance of e-Health websites. In other words, the interface should be mapped to the average users' expectation, while advanced functionalities/features could be accessed based on how much the user needs to learn or explore.

The results indicated that Trust is significantly correlated with intention to use e-Health ( $r = 0.282$ ,  $p = .000$ ). This significant correlation indicates that increasing individual's trust in a system leads to an increase in an individual's intention to use e-Health services. Trust is important as if the user feels threatened or in doubt about the misuse of their personal data, they would be reluctant to provide such information, which in turn would prevent them from using the service. The implications of this particular correlation are that e-Health websites services should only ask for the personal information if they are perceived as essential by the users. Financial information is always sensitive, so if the user accessed a chargeable service, great effort should be made to help the user feel safe about providing their financial information. This could be achieved by displaying the security measure that the site is adopting to safeguard their details and the transaction.

Other results indicated that Collectivism/Individualism is significantly correlated with intention to use e-Health ( $r = 0.195$   $p < 0.01$ ) but the actual size of the correlation is quite small. Earlier descriptive statistics suggested those participants are more collectivist in nature than being individualistic when it comes to their health issues. The majority 72.92% indicated that they preferred to share and learn from others' health experience, and did not feel threatened by exposing their health related issues to the wider e-Health community. e-Health websites/services could therefore benefit from incorporating and facilitating social networking through their online presence as this may positively influence the users' behavioral intentions to use the service, as they could feel that they are supported by the wider community.

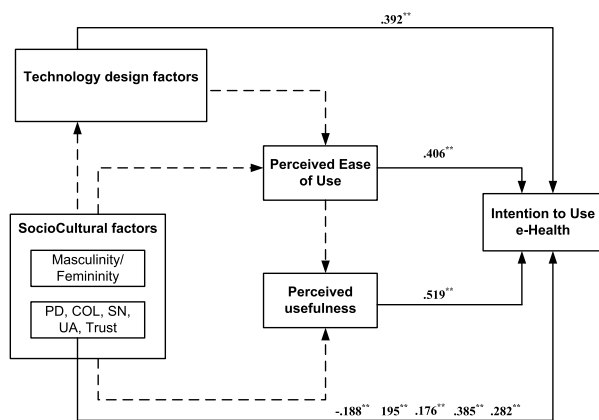
The results indicate that Power Distance is significantly negatively correlated with intention to use e-Health ( $r = -0.188$   $p < 0.01$ ). This suggests that the less information is provided the more negatively the system will be perceived, which will negatively impact on the acceptance of e-health websites. As culture is defined as low context and high context [3, 8], the interface should be intelligent enough to 'cash in' the sufficient amount of information based on the user's cultural profile, as having a static interface with either too much or minimal information will affect the overall acceptability of the service.

Masculinity/Feminism is correlated with I2U but the correlation was not statistically significant. It would appear from this that traditional gender roles do not have any real influence on intention to use..

The results indicated that Subjective norms are significantly correlated with intention to use e-Health ( $r = 0.176$   $p < 0.01$ ). Subjective norms refer to the influence others can make on someone's intention to commit to an action. The results indicate that subjective norms have only a moderate correlation with intention to use e-Health websites. Subjective norms cannot be directly modeled in the interface, however, it is weakly associated with intention to use through the effect users can make on other's intention to use e-health services.

Based on the above results, a refined e-HTAM model has been produced which is represented in figure 1.

Figure 1: e-HTAM-2 Refined Model



The direct relationship between the variables and the intention to use e-Health services has been represented by solid arrows, while the indirect relationship with the intention to use has been represented by scattered arrows, as illustrated.

### 3. CONCLUSION

This paper reports on a second study analysing the influence that technology design and cultural factors can have on users' behavioural intention to use e-Health services. Improvements were made to the initial questionnaire instrument employed in the previous study.

Descriptive analysis was performed to test data distribution among the dimensions, where it was clear that the participants were in favor of culturally-aware e-Health services, however, in order to achieve the best acceptance level (or as described here, intention to use) various issues need to be taken into consideration from the initial design stage. This was further confirmed by the correlation analysis, where the majority of the tested variables were found to be significantly correlated with the intention to use e-Health services.

The analyses suggested that when creating e-Health websites or services, the principle of how they should be designed, delivered and under which cultural setting they will be used should be taken into consideration from the initial design stage.

### FUTURE DIRECTION

The outcome of this paper is currently being employed to

inform the design and development of a user-centered, culturally-aware health informatics prototype for diabetic patients. The findings of this paper could also be used by health organizations to inform the design of a more user friendly e-Health applications interfaces.

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