Cross-Platform Cross-Cultural User Experience

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Many interactive systems can be accessed across a range of different platforms, enabling cross-platform services and allowing users to migrate their tasks from one platform to another. The aim of this study is to investigate the culture-related experiential side of using multiple interactive systems across platforms by studying users from different cultural backgrounds. In this paper, we present our findings from a user study of five cross-platform services. We conducted the user study in Australia and Saudi Arabia. Participants in Australia and Saudi Arabia interacted with English and Arabic versions of the services respectively. We used think-aloud protocol, observation and questionnaires to gather data. During our experiments, each participant performed a set of inter-related tasks using a cross-platform service across two devices: laptop and mobile phone. We identified five objective cultural factors (direction, translation, meaning of icons, formatting, and typing interface) that influence cross-platform user experience. The power distance and uncertainty avoidance subjective cultural dimensions also influenced user perception of cross-platform services. Based on our findings and analyses, we propose a design model that encompasses these cultural factors to guide designing international cross-platform services.

Cross-Platform; Cross-Device; Cross-Cultural Studies; User Experience; Interusability; User Interfaces.

1. INTRODUCTION

In multi-platform user interaction, users can perform their tasks on multiple devices including office desktops, laptops, tablets and mobile phones. This requires users to interact with multiple user interfaces cross-device to achieve inter-related goals (Seffah et al., 2004). Users from different cultures can have different needs, preferences, challenges, and expectations (Marcus and Gould, 2000), and so mismatches between users’ cultural needs and interface designs can influence user experience of the interactive product. Despite the increased worldwide use of cross-platform services, there is limited research on how culture can affect the way people perceive and approach their interaction with cross-platform services. Thus, we conducted a user study with five cross-platform services, to investigate the cultural elements of cross-platform user experience. Based on our findings, we have constructed a cross-cultural design model for cross-platform service experience, which is the key contribution of this paper.

An example scenario of cross-platform user interaction involving an online shopping service commences with a user finding a product from an online shopping application using a mobile phone. The user then switches to the desktop computer to buy the same product using the website for the online shopping service. This new theme of cross-platform interaction may result in very different user experiences (UX) (Segerståhl and Oinas-Kukkonen, 2007; Väänänen-Vainio-Mattila et al., 2009).

In the next sections of this paper, we present a summary of related research, followed by the methodology for our user study, the analyses and findings. We present our cross-platform cross-cultural user experience model and conclusions.

2. BACKGROUND

In this section, we explain concepts related to cross-platform service and configuration. We explain differences between traditional usability and cross-platform usability and between traditional UX
and cross-platform UX. In addition, we describe the cultural dimensions, and cross-cultural factors of user interfaces.

2.1. Cross-Platform Service and Configuration

Interactive cross-platform systems are known by several terms, including Multiple User Interface (MUI) to define views of the same information and services that can be accessed by users from different computing platforms (hardware and software) (Majrashi et al., 2015; Nilsson, 2006; Pyla et al., 2006; Samaan and Tarpin-Bernard, 2004; Seffah and Javahey, 2005; Seffah et al., 2001). The terms Multiple Platform User Interface (Ali et al., 2002; Meskens et al., 2008), Distributed User Interface (Bång et al., 2005; Gallud et al., 2011), multi-channelling, and cross-media (Segerståhl, 2009) have also been used to describe interactive systems cross-platform.

In this paper, we use cross-platform service to refer to the set of user interfaces of a single service on two or more computational platforms. The term’s purpose is to emphasis the user experience of transferring from one platform to another to carry out tasks.

The configuration of cross-platform services can be based on different user or business needs, or on some specific platform’s constraints or capabilities (Wäljas et al., 2010). Denis and Karsenty (2004) identify three degrees of device redundancy with respect to data and function availability: redundant devices, complementary devices and exclusive devices. Redundant cross-platform interactive systems allow access to the same data and functions, whereas complementary systems have a zone of shared data and functions across platforms, but with one or more of the devices providing access to data or functions that are inaccessible on the other device(s). With the exclusive degree, each system gives access to different data and functions. More detailed background of cross-platform service configuration including device organisation and service delivery can be found in work by Majrashi et al. (2015).

2.2. Cross-Platform Usability and User Experience

Preece et al. (1994) define usability as ‘a measure of the ease with which a system can be learned or used, its safety, effectiveness and efficiency, and the attitude of its users towards it’. This is only one of many definitions, as there is no agreed standard definition in the literature (Bevan, 1995). Cross-platform usability has a different nuance to traditional usability (Denis and Karsenty, 2004; Majrashi and Hamilton, 2015; Majrashi et al., 2014; Majrashi et al., 2015; Seffah et al., 2004), which concerns itself with characteristics of a system, such as “ease of use”, within a specific platform. Usability of such systems can be improved by applying specific design principles or guidelines, such as Nielsen’s ten usability heuristics (Nielsen, 1995), and guidelines for a specific interface (Gong and Tarasewich, 2004; Seong, 2006).

Cross-platform usability (or inter-usability) deals with the ease of use of multiple user interfaces and how well users can reuse their knowledge and skills for a given functionality when switching between devices (Denis and Karsenty, 2004). Cross-platform user experience also differs from traditional user experience (Väänänen-Vainio-Mattila et al., 2009). While traditional user experience considers user perceptions of using an interactive product in particular contexts of use (Hassenzahl, 2005), cross-platform user experience (or distributed user experience) considers interaction with a system involving multiple interaction devices or styles (Segerståhl and Oinas-Kukkonen, 2007; Väänänen-Vainio-Mattila et al., 2009).

2.3. Culture

A popular model of culture divides it into subjective and objective elements (Ford and Kotzé, 2005; Hofst, 1996). Objective culture consists of the tangible artefacts of a culture, such as its customs, arts and language. From an interface perspective, the relevant elements from the objective culture domain can include the language; date, time and number formats; symbols; and even processes. Subjective culture concerns itself with cultural values.

National culture (or cross-cultural) research focuses on defining values that distinguish one group from another. Hofstede’s work (Hofstede and Bond, 1984; Hofstede et al., 1991) is the most popular and highly cited conceptualisation of national culture (Bond, 2002). Hofstede’s research began in 1980, with 116,000 questionnaires from over 60,000 people from over 50 countries. Through standard statistical analyses of large data sets, he labelled similarities and differences among responses to identify a set of dimensions of culture. The dimensions relevant to our study are power distance, uncertainty avoidance, individualism-collectivism, and masculinity-femininity, forming a basis for cross-cultural characterisations (Dorfman and Howell, 1988; Schneider and Barsoux, 2003).

The Power Distance (PD) dimension is defined as “the extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally” (De Mooij and Hofstede, 2010). The Masculinity-Femininity (MF) dimension refers to
values that can be dominant in masculine or feminine societies. For example, achievement and success are examples of the dominant values in a masculine society, while caring for others and quality of life are examples of the dominant values in feminine society (De Mooij and Hofstede, 2010). The Individualism-Collectivism (IC) dimension is used to refer to the strength of the links between people within a community. In a country that tends to be more individualist, people look after themselves and their close family. In a country that tends to be more collectivist, people have strong group cohesion with respect for members of the group being important, as well as loyalty to the group (De Mooij and Hofstede, 2010). The Uncertainty Avoidance (UA) dimension refers to the degree of anxiety that a member in any society can feel or express when in uncertain or unknown circumstances (Hofstede et al., 2010). An individual in a nation with high UA attempts to avoid unclear situations and uses traditional ways of dealing with things rather than trying new things. However, a member in a country that has a low UA score can enjoy doing novel things.

A review study by Ford et al. (2003), found that 22 per cent of worldwide information system papers cited the Hofstede’s dimensions. There are also several usability studies with the Hofstede’s dimensions providing a framework for design guidance of user interfaces or evaluating usability from different cultural perspectives (see e.g., Downey et al. (2005); Marcus and Gould (2000)). Marcus and Gould (2000) provide guidance for each of Hofstede’s dimensions based on a comparative analysis of websites from different countries. An example of Marcus’s user interface guidance based on power distance dimension is to provide highly structured access to information in interfaces that display high power distance characteristics. In terms of cross-platform UX, there are limited studies that investigate cross-platform UX with users having different subjective cultural values.

3. USER STUDY METHODOLOGY

We designed the user experience study to use five cross-platform services. Volunteer users were invited to attempt a set of inter-related tasks using cross-platform services across multiple devices. We conducted the user study in two countries: Australia and Saudi Arabia. In this section, we describe the data collection methods, evaluated cross-platform services, devices used to access the service, and implementation types (web-site or native application) of user interfaces. We also define the horizontal task concept and explain how tasks and participants were organised in the study, and the data analysis techniques used.

3.1 Data Collection

User studies can employ a variety of data collection techniques (Nielsen, 1994). Concurrent think-aloud protocol, in which people verbalise their thoughts while they are carrying out tasks, is frequently used (Austin and Delaney, 1998; Nielsen et al., 2002). Observation can also be used to gather data about users’ context, tasks, and goals (Baber and Stanton, 1996; Lazar et al., 2011). Questionnaires are also commonly used (Hamborg et al., 2004; Lund, 2001; Van-Veennendaal, 1998). Our study implemented all three data collection techniques. We recorded user verbalisations while they interacted with multiple interactive systems. We observed users, concurrently noting down design issues occurring across devices. Two questionnaires (post-transition and post-test) were used. The post-transition questionnaire was undertaken after a user completed two sub-tasks that involved moving from one device to another. The post-test questionnaire was completed after the participant had undertaken all allocated tasks. With each questionnaire, users were able to comment about their impressions of tasks across platforms with open-ended questions. With the post-test questionnaire, there were also two questions in relation to the use of colour on each platform. The participants were asked to choose a specific colour that they preferred for each user interface within each platform (laptop, and mobile).

We audio-recorded participants and video-recorded the device screens. To capture the use of the mobile devices, including users’ hands, we used video cameras.

3.2 Cross-Platform Services and Devices

We selected five cross-platform services from different domains (travel, social network, lifestyle, and e-mail). These services were Booking.com1, Facebook2, Qatar Airways3, Outlook4, and Namshi5. All the services have complementary levels of redundancy. They are available in Arabic and English languages across devices. The Booking.com (BK) cross-platform service allows users to search for accommodation and make bookings. Facebook (FB) is a cross-platform social networking service that provides such capabilities to its users as ratings and ‘like’ tagging, posting, posting, posting.

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1 www.booking.com, accessed December 2014 to March 2015
adding friends, uploading photos, creating and managing groups and editing privacy settings. 

Qatar Airways (QA) is a cross-platform airline service that allows users to search for available flights, book flights, and join reward membership. Outlook (OL) is Microsoft software that allows users to send, receive and manage e-mail. In addition to basic email features, users can customise the display and change account settings to their preferences. Namshi (NA) is a cross-platform e-commerce service for selling clothes and other items for women, men and children. Users can search for items or browse different categories, and purchase items online.

The devices used in this study were a MacBook Pro (15 inch) laptop computer, an Apple iPhone 4 mobile phone, and a Samsung Galaxy S4 mobile phone. We selected two implementations for each cross-platform service: a desktop website accessed from a laptop device, plus a mobile website or native mobile application accessed from a mobile phone.

3.3 Horizontal Tasks (HT)

We define a horizontal task to mean inter-related tasks that a user can execute across platforms. We designed each horizontal task to be as realistic as possible, for example for Booking.com (BK), participants were asked to undertake the following two subtasks, each on a different device:

- Subtask 1: Find all recently viewed hotels in the service.
- Subtask 2: Show one of the recently viewed hotels on a map.

3.4 Organisation of Tasks and Participants

Participants from Australia and Saudi Arabia were given the same horizontal tasks. Participants in Australia were given the tasks in English and were asked to interact with English versions of services, whereas participants in Saudi Arabia were given the tasks in Arabic and interacted with Arabic versions of services. The same devices were used to access each specific service in both countries.

In both Australia and Saudi Arabia, participants were divided randomly into 5 groups of 4 students. Each group performed horizontal tasks using a single service across devices. Each participant in each group was asked to complete two horizontal tasks. The first horizontal task was attempted with the order: laptop user interface and then mobile user interface. The second horizontal task was attempted in reverse order: mobile user interface and then laptop interface. This was to reduce ordering effects and inspect cross-platform UX issues with the different orderings.

3.5 Data Analysis

There were two main phases in our data analysis. Firstly, thinking aloud statements were stored with observations and users’ comments from the questionnaires in files for each participant from Australia and Saudi Arabia. In the second phase, we analysed the statements through open coding for participants from each country separately, which resulted in multiple themes for each country. Results from questionnaires about the use of colour cross-platform were used to complement the qualitative data with the related theme.

4. GENERAL FINDINGS AND ANALYSIS

In this section we describe the participants and the observations that appeared to be independent of cultural variables. The cultural variables and results are presented in Section 5. We prefix the letter E or A to the abbreviation for the service, referring to the English or Arabic version of the service respectively (e.g., E-FB for the English version of the Facebook service). An appended number refers to a participant’s identification number. For example, A-FB1 refers to the first Facebook user who interacted with the Arabic versions of the service.

4.1 Participants

Forty students volunteered to participate in this study (20 participants in Australia, and 20 in Saudi Arabia). The participants were students from RMIT University, in Melbourne, Australia, and the Institute of Public Administration (IPA), in Riyadh, Saudi Arabia. Participants were from nine different countries: Australia (4), China (5), India (2), Malaysia (2), Singapore (2), Saudi Arabia (16), Iran (4), Jordan (2) and Egypt (3). The participants’ major areas of study in Australia spanned computer science, health sciences, engineering and business. In Saudi Arabia, the participants’ major areas of study ranged across public administration, computer science, engineering and business. All forty participants had at least basic computer skills.

4.2 Global Results

Users of both the English and Arabic versions of the cross-platform services were faced with six cross-platform UX issues: consistency (how consistent are the system components across platforms), fluency (how fluently can they resume interrupted tasks after transferring from one device to another), organisation (how appropriate is the organisation of devices and functionality), learnability (the extent to which each user interface needs to be learned separately), recognition (the extent to which the user interfaces support
recognition of elements rather than requiring users to remember information from one device to another to be able to continue on with an interrupted task and transparency (the extent to which the design of each user interface is clear enough for users to understand the levels of accessible data and available functions from each device).

In Australia, across the tested services, 70 per cent of participants encountered issues regarding consistency, 75 per cent encountered fluency issues, 50 per cent encountered issues about configuration and learnability and recognition and 40 per cent encountered transparency issues. In Saudi Arabia, the percentages of participants encountering consistency issues were 80 per cent, fluency 60 per cent, configuration 55 per cent, learnability 70 per cent, recognition 40 per cent and transparency 65 per cent. Consistency, learnability and transparency appeared to be more frequent issues for those using Arabic versions of the services. Fluency seemed to be the dominant issue for those using the English versions of the services.

5. CULTURAL RESULTS

In this section, we explain the objective (language, symbols and formats) and subjective (typical society attitudes) cultural factors discovered in our experiments. Note that most users’ comments are translations.

5.1 Objective Culture

Participants from both countries reported issues related to objective culture. These were grouped under five main themes: direction (the direction of user interface elements [e.g., right to left versus left to right]), translation (the translation of user interface text and labels from their original language to another language for a group of targeted users), meaning of icon (the idea that is represented by an icon), format (formats for numerals, date, time, and currency), and typing interface (the design of the keyboard and keypad). These issues impacted how users perceived the cross-platform user experience.

5.1.1 Direction

The design of a user interface is typically influenced by the reading direction of target users. For example, Arabic speaking users are accustomed to reading right-to-left (RTL) and require user interfaces with a different layout to those targeted at left-to-right (LTR) reading audiences such as English speaking users. In the context of cross-platform user experience, fifteen participants across the tested services in Saudi Arabia who interacted with Arabic versions of the services reported several cross-platform UX issues related to the direction of the user interface design elements. Most of the issues were reported when transferring to the mobile device, since the Arabic versions of the natively English mobile apps (Booking.com, Facebook and Outlook) were not fully designed to suit RTL interaction pattern. For example, the Arabic version of the Facebook mobile app has user interface elements on the left not swapped to the right to suit Arabic users. Users perceived this as an issue that impacted the smoothness of the transition to the app. One user commented:

“The transition to the desktop website is smoother than transferring to the mobile app due to the app not supporting my reading pattern. There is no smoothness of transition if everything is organised and displayed from left to right. It is difficult for me as an Arabic user who reads from right to left to quickly engage with a user interface that displays its components in the opposite direction to my reading pattern, and different from the previously used interface [desktop website].” (A-FB3)

With Booking.com and Outlook, most users who interacted with the Arabic versions perceived the services as inconsistent cross-platform since the mobile apps organise elements LTR different to the direction on the desktop website RTL. One booking.com user commented:

“The check-in and checkout fields in the search form are ordered from left to right. I became aware of this after several attempts of entering dates to the fields. I think the user interfaces are not consistent enough.” (A-BK1)

Users of Arabic versions of the Qatar Airways service appreciated using the service cross-platform, however they also requested more customisation of the user interfaces to support RTL interaction pattern. One user commented:

“Both user interfaces have been Arabicised, however designers did not Arabicise the direction of things such as calendar components in those user interfaces, whereby when I want to go forward, I click the left which is confusing. I should click the right arrow to go forward.” (A-QA1)

For English versions of the services, three participants across the tested services encountered issues regarding the direction of elements in the user interfaces cross-platform. One user reported that the Qatar Airways desktop website displays some elements from right to left. The users
reported that this issue impacted negatively on the continuity of their task after the transition.

“The user interfaces have been translated to English but the widgets in the website have not been organised from left to right. Thus, it was not easy to continue on the task smoothly.” (E-QA4)

5.1.2 Translation

Six participants encountered issues regarding translation in the Arabic versions of services while none of participants encountered translation issues in the English versions of services.

Within Qatar Airways, most of the users with Arabic versions of the service encountered incorrect and inconsistent translations between the user interfaces. The service translates the same content differently across devices, which confused the users. One user stated:

“The inconsistency of translation and incorrect translation was the biggest issue I faced.” (A-QA1)

With the Arabic versions of Booking.com, some users reported that the inconsistency of terminology of a menu item affected their capability to resume the second horizontal task. The service translated the label of the same navigation menu item differently cross-platform. One user commented:

“The language used in the mobile app was different from the website, for example, viewed recently versus recently seen. This delayed me from resuming the task so I felt the transfer between the two user interfaces was not smooth enough.” (A-BK1)

5.1.3 Meaning of Icons

Ten participants across the tested services encountered issues about the meaning of icons when they interacted with Arabic versions of the services across platforms. With English versions, four participants encountered issues relating to the meaning of icons.

We found some icons represented different meanings for users from the different cultures. For example, with Booking.com, an icon with a heart shape is used for saving the hotel function. All Booking.com users in Australia and Saudi Arabia who reached the stage of the task to save a hotel reported that the icon was not meaningful for saving, except for one user of western background. When asked after the testing session if the heart icon meant anything to him, he responded that the icon was meaningful. In the context of cross-platform user interaction, one user emphasised the importance of using meaningful icons which need to be consistent cross-device. This user took much time before he was able to resume the interpreted task after transferring from one interface to another since the icon for the targeted element was not consistent cross-platform.

“The website showed good meaningful icons, however the mobile app did not use the same icons and they were not meaningful. I think both user interfaces should use the same clear icons that can communicate the same meaning as this can make my use of the service from any device easy and fluent.” (A-BK4)

5.1.4 Format

There is an expectation for user interfaces to be adapted for the cultural differences of their intended target audience. This includes cultural preferences such as the format of numerals, date, time and currency. In our study, we found that participants mostly complained about issues such as the lack of user interface adaptation to the Arabic culture and the inconsistency of formatting elements, such as numbers, between user interfaces cross-device. With the Arabic versions of Booking.com, participants complained about the inconsistency of numeric formats when they selected check-in and checkout dates with the Booking.com service cross-device because the Arabic language uses Hindi numbers. However, the participants were presented with Arabic numbers via the website and Hindi numbers from the mobile app. One participant commented:

“The mobile app used Arabic numbers [Hindi numbers] which is different to the website..... I think they should use Arabic numbers [Hindi numbers] in each user interface for consistency.” (A-BK1)

5.1.5 Typing Interface

In this section, we use the term “keypad” to refer to the virtual keyboard used on mobile phones. Thirteen participants who interacted with the Arabic version of services encountered cross-platform issues related to the design of the keyboard and keypad. However, none of the participants who interacted with the English version of the services had this type of issue. In our study, we used Apple Mac laptops, with QWERTY keyboard layouts, which is the common modern-day keyboard layout for Latin script. For the Arabic language, we used the Mac Arabic keyboard layout, in which both Arabic and Latin appear on the keyboard, as Latin characters are necessary for URLs and Email addresses (See Figure 1).
The Samsung and iPhone mobile phone keypads are different for Arabic, see Figure 2, where (1) shows Arabic letters, and (2) demonstrates symbols for the Arabic language for the Samsung device, and annotations (3), (4), and (5) show Arabic letters, numerals and symbols, and marks (Tashkeel) respectively for the iPhone. On the Samsung device, the keypad does not include the numerals used in Arabic, which are Hindi numbers, and marks (Tashkeel).

"There was no way to make Tashkeel from the mobile device. Sometimes the meaning of words changes if Tashkeel have not been used." (A-OL4)

Several users also complained about the inconsistency of letter placement between the keyboard and the keypad. For example, with Outlook, one user needed to enter the Arabic letter "س" (d: dāl) from both devices (the Mac laptop and the Samsung mobile device). The placement of the letter was not consistent between the keyboard and the keypad. The user commented:

"I don’t know where the letter "س" (d: dāl) is on the MAC [keyboard]. It is not consistent with the keypad." (A-QA1)

Concerning the Mac keyboard and the iPhone keypad, some users appreciated the placement of the most frequently used letters in Arabic "أ" (a: alif) and "ي" (l: lām) in the same place within the keyboard and keypad. However, one user requested more consistency in the order of letters, symbols, and Tashkeel (marks) between the keyboard and the keypad.

6. SUBJECTIVE CULTURE

The participants in our study displayed sensitivity to issues related to some of Hofstede’s cultural dimensions. Table 1 shows the distribution of participants according to Hofstede’s cultural dimensions, based on country of origin. The distribution of participants is based on the variables values found by Hofstede et al. (2010), which are between 0 (low) and 100 (high), with 50 as a midlevel. We use a two-category classification, such that countries which have values between 0 and 49 represent a low power distance, individualism, femininity, or low uncertainty avoidance respectively and a value of 50 to 100 represents high power distance, collectivism, masculinity and high uncertainty avoidance. Note that for our study all high power distance countries are also collectivist countries. While it is a generalisation, for our analysis we assume that all participants from the same country exhibit the typical properties found by Hofstede et al. (2010).

Table 1: Distribution of participants based on their cultural dimensions (n = 40)  

<table>
<thead>
<tr>
<th>Cultural Variable</th>
<th>Country and number of participants</th>
</tr>
</thead>
</table>

6 Every country contains participants that fall into more than one cultural variable so the number of participants is more than forty in Table 1.
We analysed users’ comments from the different cultures and found that users from Saudi Arabia, China, Malaysia, Jordan and Egypt emphasised that both user interfaces needed to show clear structured designs with enough information about the company or organization behind the service. Users from Australia, Iran, Singapore and India did not report issues with structured design or information about the company or organisation from each instance of the service cross-platform.

Users from Saudi Arabia, China, Malaysia, Jordan, and Egypt belong to the group of high power distance and collectivist cultures (see Table 1). Since collectivism refers to the strength of the links between people within a community (Hofstede and Bond, 1984; Hofstede et al., 1991), it seems to be not relevant to the issues reported by users from those countries. High PD countries tend to exhibit tall hierarchies in organizations (Hofstede and Bond, 1984; Hofstede et al., 1991). This variable might be more relevant than collectivism since users who expect hierarchies in an organisation could also require clear structured designs with enough information about the company or organization that runs the service for each user interface.

We also found that some users from Saudi Arabia, Iran, Jordan, and Egypt reported that they felt that they needed to avoid taking a new path with the second interacted-with user interface that is different from that taken when they interacted with the first user interface. This is when they attempted to resume the interrupted task after the transition from one device to another. One user stated:

“I felt I needed to avoid taking any new route to achieve my task from the mobile app and I should use the same route for the tasks that I used from the website. I didn’t want to make errors.” (A-FB3)

Users from Saudi Arabia, Iran, Jordan, and Egypt who reported the need to avoid taking a new path after the transition from one user interface to another fall under three cultural variables: high PD, collectivism and high UA. People from a culture with high UA can feel anxiety about uncertain or unknown matters, thus this factor seems to be the most pertinent factor on users’ feelings of avoiding taking a new path to complete the interrupted task after the transition.

Some users from Australia, Saudi Arabia, Iran, and Egypt emphasised the importance of showing minimal content in both user interfaces cross-platform to eliminate the ambiguity of the level of data and functions that can be accessed from each platform. However, some users from China, Malaysia, Singapore, and India reported the need for showing the maximal content on the central service (desktop website), and reducing the content on mobile apps. The users who recommended showing minimal content were all from high UA countries, whereas users who reported the need for showing the maximal content on the central service were from low UA countries. Therefore, UA also appears as an affecting factor on cross-platform user experience.

In relation to the use of colour, four users out of the forty participants commented about the use of colour cross-platform. Two of those users (from Saudi Arabia and Iran) preferred to have the same theme colour in each instance of the service cross-platform for maintaining the same feeling when using the service cross-device. The other two users who preferred to have a separate colour for each user interface cross-platform were from China and Iran. Those two users argued that having a separate colour for each user interface would give an indication that the user is currently working on a specific device when switching between user interfaces.

Since we found that only four users out of the forty participants commented about the use of colour cross-platform, there was insufficient data to investigate differences about colour between cultures based on users’ comments. We therefore conducted further investigations on users’ preferences of using colour cross-platform based on our quantitative data. We had two questions in the post-test questionnaires in relation to the use of colour in each platform. The participants were asked to choose a specific colour that they prefer for each user interface within each platform (laptop,

<table>
<thead>
<tr>
<th>Low Power Distance (PD)</th>
<th>Australia (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Power Distance (PD)</td>
<td>Saudi Arabia (16), China (5), Iran (4), Malaysia (2), Singapore (2), India (2), Jordan (2), Egypt (3) Total: 36</td>
</tr>
<tr>
<td>Individualism</td>
<td>Australia (4)</td>
</tr>
<tr>
<td>Collectivism</td>
<td>Saudi Arabia (16), China (5), Iran (4), Malaysia (2), Singapore (2), India (2), Jordan (2), Egypt (3) Total: 36</td>
</tr>
<tr>
<td>Masculinity</td>
<td>Australia (4), Saudi Arabia (16), China (5), Malaysia (2), India (2) Total: 29</td>
</tr>
<tr>
<td>Femininity</td>
<td>Iran (4), Singapore (2), Jordan (2), Egypt (3) Total: 11</td>
</tr>
<tr>
<td>Low Uncertainty Avoidance (UA)</td>
<td>China (5), Malaysia (2), Singapore (2), India (2) Total: 11</td>
</tr>
<tr>
<td>High Uncertainty Avoidance (UA)</td>
<td>Australia (4), Saudi Arabia (16), Iran (4), Jordan (2), Egypt (3) Total: 29</td>
</tr>
</tbody>
</table>
and mobile). We found 28 participants (70 per cent) out the forty participants preferred the same colour for each user interface cross-device. Twenty-seven (96.42 per cent) participants out of the 28 participants who selected the same colour for each user interface cross-device were from countries that have a value of more than 50 for uncertainty avoidance variable (Australia, Saudi Arabia, Iran, Jordan, Egypt). Only one out of eleven participants from low uncertainty avoidance countries preferred to have the same colour for both interfaces. This might emphasise that the uncertainty avoidance cultural variable influences cross-platform user experience.

7. CROSS-PLATFORM CROSS-CULTURAL UX DESIGN MODEL

Since we found that both objective and subjective cultures impact on user experience cross-platform, we recommend taking into consideration these different cultural factors when designing international cross-platform services. Based on our findings and analysis in the previous section, we provide a cross-cultural design model for cross-platform service UX. The model shows important cultural elements for the design of international cross-platform services (See Figure 3).

![Cross-Platform Cross-Cultural UX Model](image)

**Figure 3: Cross-Platform Cross-Cultural UX Model**

To improve cross-platform UX services for users from different cultures, designers need to design the services with support for the user’s reading pattern (e.g., RTL, and LTR) cross-device. Designers also should make sure that texts and labels are translated properly with the same terminology cross-device. The use of the same icons on all user interfaces should also be considered, to support cross-platform UX. The icons should be meaningful to all users from the different cultures. Customising cross-platform services to satisfy a specific culture’s needs, such as number format, is another important designable characteristic for cross-culture cross-platform services.

The design of the cross-platform service should also consider subjective cultural dimensions. Power distance and uncertainty avoidance are two cultural variables that impact user experience cross-platform, based our results. Therefore, we recommend that designers consider the following:

- Design cross-platform services for High PD:
  - designs of user interfaces from all devices to provide a clear structured-design with adequate information about the organisation that runs the service. This appears to have no negative impact on low PD users, but improves the experience for high PD users. This partially agrees with the observation of Ford and Kotzé (2005) that high PD interfaces are more usable for all cultures.
- Design cross-platform services for High UA:
  - Support operational consistency when designing the service by having the same tasks’ paths from each user interface as users from high UA prefer to avoid new task paths after the transitioning process.
  - Design with only minimalist core features from each user interface to reduce ambiguity for understanding levels of accessible data and functions from each user interface.
  - Use the same main theme colour for each user interface.
- Design cross-platform services for Low UA:
  - Design should show maximal content on the central service (desktop website), and reduce the content on mobile apps.
  - A different theme colour can be used for each user interface to match user preference.

The design of typing interfaces impacted the cross-platform user experience since some users found that the keypad was incomplete, inconsistent with the keyboard, and incompatible with user language in some cases (e.g., different numeral format). Hence, they should be considered when designing for better cross-platform user experience in general and to support user cultural needs. Completeness, consistency of keyboard and keypad and compatibility with users’ language across devices are the three essential factors for designing the keyboard and keypad. The typing interfaces are not
usually associated with the design of the service as they are dependent on device manufacturers. Therefore, service UX designers are unlikely to have control over their design. However, UX designers can take the existing typing interface design into consideration, reducing the impact of any limitations. For example, they may reduce unimportant functions from mobile apps that require users to type, if the keypad has an inconsistent design in comparison to the keyboard.

The design of the cross-platform service should also consider the key cross-platform UX elements, which were identified by users from all cultures including: consistency of system components across devices (e.g. ordering and placement of elements), task fluency (e.g. after the transition from one interface to another, the service needs to resume last operations performed with the transferred-from user interface automatically), organisation (of devices and functionality), learnability (when a user learns the procedures to do specific tasks from a specific user interface, they should be able to do the same tasks after transitioning to another interface without the need for new learning), recognition (designs should support recognition rather than recall to help resuming the task easily without the need for users to remember information from one interface to another) and service transparency (designs should allow users to understand the accessible data and functions from each user interface).

8. SUMMARY

In our study, we found that users of both English and Arabic versions of the cross-platform services were sensitive to six cross-platform UX elements:

- consistency of system components across platforms,
- fluency of resuming interrupted task after transferring from one device to another,
- organisation of devices and functionality,
- learnability of the service,
- the extent to which user interfaces support recognition of elements rather than recall after the transitioning process, and
- transparency of each user interface.

We found also objective and subjective cultural factors that most influence cross-platform user experience.

- The objective factors are service related (direction, translation, meaning of icons, format) and device related (typing interface design). These factors impacted how users perceived cross-platform services in terms of consistency and fluency.
- The subjective factors are power distance and uncertainty avoidance. These factors impacted how users from different countries perceived cross-platform UX issues differently.

For improving user experience cross-platform, we have proposed a model to guide designers when building international cross-platform services.

We acknowledge that our study is based on university students and that most participants were from high power distance cultures, which may limit the generalisability of the results.

Further focused user studies on subjective cultural dimensions are still needed to identify all possible subjective issues that could influence cross-platform user experience, and to confirm our findings.

9. REFERENCES


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