Research Article

A Delphi Evaluation of User Interface Design Guidelines: The Case of Arabic

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Due to the importance of design guidelines in facilitating user experience and promoting efficiency, it is essential to determine the effectiveness of certain design guidelines for a specific population. There have been a number of challenges reported in the literature when designing learning courses for Arabic users. Confirming the suitability of design guidelines for specific users' needs can be challenging in the context of the Arabic language. This is mainly due to the unique characteristics of this language, which contribute to users' satisfaction with the interface. This study evaluated the feasibility of using Arabic User Interface (UI) guidelines for tablet PCs. The UI guidelines were developed, evaluated, and refined using the Delphi technique. A total of six UI design experts were recruited for this study. The results revealed a number of guidelines that can be used in the design of Arabic UI. The proposed guidelines can standardise the design of Arabic UI by offering future directions on how to effectively apply design principles for tablet PCs.

1. Introduction

The recent rise of various UI design guidelines and recommendations for learning has widely influenced users' learning in different settings [1]. The tablet PC becomes a necessary tool to benefit the learning process by bringing visual elements to class, enhancing collaborative learning, and reducing the need to bring everything to the classroom [2]. Tablet PC devices are changing the face of learning in educational systems [3, 4]. Therefore, many Arabic countries have adopted e-learning techniques to improve their educational services and develop their existing systems [5]. The first author's personal experience encourages this view as a teacher and lecturer within Arabic educational organisations (schools and universities), where information and communication technology (ICT) has been enthusiastically accepted. Many of these universities and institutes embrace the latest technology to help students and teachers achieve their learning goals [5].

UI guidelines can potentially steer designers and developers toward positive decisions that improve their product designs [6]. The literature supports our initial investigation that no Arabic UI guidelines for tablet PCs are available for Arabic designers. Muhanna and Jaser [7] concluded that Arabic UI guidelines had been neglected in previous works. The design guidelines provide a uniform language to harmonise the constancy, appearances, and action sequences of different designers [8]. The design guidelines document must be based on practical experience or experimental studies with appropriate examples. Therefore, to design a usable UI that helps designers achieve their goals, designers and developers need to consult guidance documents and evaluate the result with end users. Arabic designers and developers also need such a document. An empirical approach was adopted in this research project.

This method allowed us to directly observe and deal with end users [9] while they are interacting with tablet PC applications, allowing more accurate data to be collected.

In general, UI design guidelines constitute a collection of recommended or suggested documents that help designers and developers create application UIs. Guidelines offer more specific design aids at a lower level of abstraction than principles. Whereas principles are the design goals, guidelines show how to achieve these goals within a specific context [10]. Both help and encourage designers to adopt the same appearance and feel as the platforms that will run their devices. Therefore, companies can ensure that their application works with the operating system and meets the individual user expectations of each platform [11]. To accomplish these requirements, designers and developers need resources and concise, clear guidelines that ensure the usability of their developed applications and websites. Therefore, many manufacturers have based their UI guidelines on user experience, usability, and principles.

The literature for design methods for UI guidelines is plentiful. As an alternative to literature surveying, Gale [12] suggested a brainstorming process and collaboration among developers and users. Although intended to generate more representative guidelines, Gale reported that the resulting UI guidelines might specify only general design requirements. Many methods purporting to overcome these issues have been proposed. For example, Campbell [13] and Kim [14] proposed a systematic procedure for developing ergonomic guidelines that provides the general rules for each design phase. However, as pointed out in several previous studies, this approach may not truly reflect specific design needs.

Some researchers (e. g., Vanderdonckt [15] and Vogt [16]) argued that the challenges imposed by design guidelines might compromise their role as a supporting tool in the design stage [13]. This can be reasoned that UI guidelines might have been mainly designed to reflect the general design requirements [12]. The Arabic language has unique characteristics [7, 17–19], such as directions, where Arabians write alphabetically from right to left. However, the number will be from left to right. Also, Arabic words occupy more space horizontally than English words. Moreover, Arabic has diacritic signs (also called vocalisation marks) that appear above or below the letters. In this paper, we are presenting the final stage of our development, named the Delphi study. The first four stages were published in [20, 21]. The next section discusses the UI guidelines development process for Arabic users.

2. UI Guidelines Development

To develop UI guidelines for Arabic designers and developers, this research has five main stages, including three empirical works and two further stages. The development project was motivated by a strong demand to improve user interfaces (UIs) for the Arabic language. Educational applications and tablet PCs were focused on, and the designers and developers of Arabic UIs were targeted. This study was guided by the main research questions, stages, and

objectives. The objectives of the research design and their corresponding objectives are summarised in Table 1.

3. Delphi Study

In this paper, we presented the final stage (E), which focuses on the evaluation phase. The Delphi technique was used because it helps to focus on the ideal rather than the individual. Also, the subjects must be assessed over long geographical distances within the cost restraints and time limits of the study. Before creating the final version of the UI guidelines, the initial guidelines were reviewed by experts (Jordanian designers and developers) in a Delphi group. Design practitioners are the natural choice for examining the initial guidelines in the Delphi study, as they are the target users of our artifact. The Delphi technique was appropriate for the following reasons; first, the study required the knowledge and experience of experts in tablet PC and mobile UI design. The experts were the same designers and developers we had previously interviewed in Jordan. The designers and developers were mixed between intermediate (less than five years) and experts with over eight years' experience. Second, the Delphi study requires no direct communication among the group members, saving travel time and cost. In the Delphi method, the experts can recognise and rate the elements of the design guidelines through their experience with the previous project on Arabic interfaces. Third, Delphi studies are often used to discover a consensus view amongst experts.

Numerous studies [22–24] have highlighted the Delphi technique as a simple source of information. It includes the biases of various experts and approaches to the truth through agreement [25]. In addition, the written and controlled feedback in this approach limits the subject-researcher interaction [22]. For the purpose of the Delphi study, Jordanian designers were invited to review the initial guidelines. The Delphi study constituted the final part of the study design, namely, the evaluation phase of the design science research methodology. Our research question was "To what extent do the proposed design guidelines satisfy the designer's needs?" The research question was originally shaped to refine the draft guideline.

3.1. Validity and Reliability. According to Marsland et al. [26], the Delphi research design provides a more in-depth and detailed analysis than the quantitative research design. A study by Franklin and Hart [27] demonstrated that the Delphi study improves the effectiveness of the first-round questions. Accordingly, a thorough review of the literature is essential to confirm that the first-round questions contain recent information. Meanwhile, researchers must ensure that the first-round questions include all components, from which experts can note the most "in the moment" ideas Franklin and Hart [27]. Since the reliability of the first-round questionnaire cannot be confirmed because of the qualitative nature of this assessment [27], two experts were asked to judge the validity of the questions. Franklin and Hart also recommend that the validity and reliability of the study

TABLE 1: Research design.

Research questions (RQ)	Stage	Objectives	Research methods
What are the current UI design practices in use by Jordanian designers and developers?	Stage B	To understand the UI design process in Jordan and the need for UI guidelines	Interview, questionnaire, and video conferencing
What are the current challenges for UI designers in Jordan?	Stage B	To identify the challenge of UI supporting tools and offering the Arabic UI guidelines as a solution. Then determine the key components of the target UI guidelines	Interview, questionnaire, and video conferencing
What are the design preferences for Arabic educational applications among students of a different gender?	Stage C	To identify users' preferences for an educational Arabic tablet PC application.	Coaching thinking aloud
	Stage D	To design Arabic UI guidelines for an educational Arabic tablet PC application.	Coaching thinking aloud and literature survey
To what extent do the proposed design guidelines satisfy the designer's needs?	Stage E	To refine and assess UI design guidelines that produced the previous research question	Delphi study

depend on the researchers' skills and experience. We invited two professors from Auckland University of Technology (AUT) to discuss and refine the questions with the main researcher before sending the questionnaire to the target respondents.

3.2. Experimental Design and Procedure. Traditionally, the paper-based Delphi technique was disadvantaged by the long turnaround time of mailing multiple surveys back and forth [28]. Therefore, the Delphi technique in this study was electronically deployed through the website https://edelfoi.fi (Delphi Decision Aid), which allowed the participants to submit their responses online. As explained by Van de Ven and Delbecq [25], the Delphi procedures include a minimum of two-round questionnaires and feedback reports. The initial-round questionnaire may contain open-ended questions or questions that reflect specific formats. After syndicating and analysing the initial-round questionnaire answers, we constructed the second-round questionnaire, which reveals the overall group response and the individual responses of users. When designing this questionnaire, we referred to the respondents' answers in the first-round questionnaire. In this study, expert designers and developers were invited to participate through the Delphi Decision Aid website. The researcher (administrator) sent a quick welcome mail and emailed the study's intentions and objectives to the potential respondents. To accept the invitation, the respondents clicked on the link attached to the e-mail, which transferred them to the edelfoi.fi website, where they read the guideline documents and answered the questions. Both experts were able to view each other's responses, enabling them to refine and finalise their decisions about the questions. The process was completed when adequate information had been collected, or when the experts agreed that sufficient information had been gathered (see Figure 1).

3.3. Setup of the Guideline Document Website. In the first step of the Delphi procedure, the UI design guideline documents were set up on the Delphi Internet site https://edelfoi.fi/, which offered useful and flexible online tools. Figure 2 shows the initial setup of the guidelines and first-round questions.
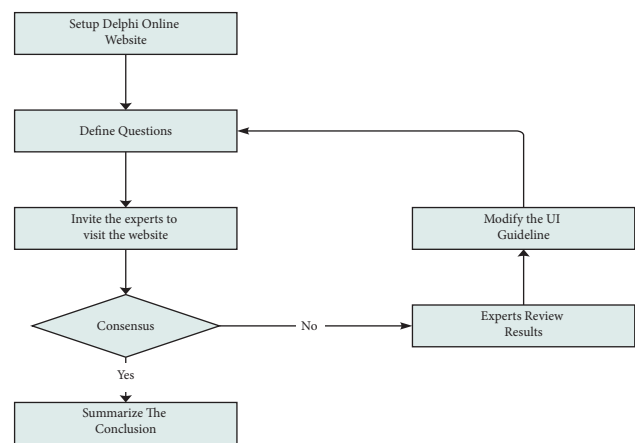

FIGURE 1: Flowchart of the Delphi procedure.

3.3.1. Setup Queries (Questions). The guideline document contains three main sections: the UI preferences (font type, font size, font colours, button, alignment, and menu type), the religious UI guidelines, and the general design principles.

3.3.2. Define the Research Questions. Through the Delphi technique, we refined our UI guidelines and principles. The main Delphi study was implemented as a series of questions. To answer our research questions, the experts' panel was anonymously requested to provide qualitative feedback on the UI guidelines and principles.

3.3.3. Invite Experts to the Panels. Among 13 designers and developers invited to participate by e-mail, we recruited six participants; five Jordanian designers and developers and one Jordanian Ph.D. student (who also works as a UX researcher at the university). Here, to maximise the neutrality of the study, we invited the designers and developers who had participated in the previous study. The same experts had supervised the development of UI for tablet PCs and mobile applications in their Jordanian companies. The Ph.D. student (labelled D1 in Table 2) was recruited to ensure an academic balance of ideas and opinions. The student

FIGURE 2: Setup of the Delphi study.

TABLE 2: Demographic information of participants in the Delphi study.

	P#1	P#2	P#3	P#4	P#5	D1
Age group	25–34	35–44	25–34	35–44	18–24	25–34
Gender	Male	Male	Male	Male	Female	Male
Experience	2–4 years	>8 Years	5–8 years	>8 Years	2–4 years	PhD student

specialises in the computer field and is familiar with the study and its terminology. Table 2 summarises the demographic information of the six participants.

Adler and Ziglio [29] noted the following four requirements of expertise: (i) knowledge and experience with the investigated issues, (ii) ability to participate, (iii) sufficient time to participate, and (iv) communication skills.

All experts were expected to be experienced in designing Arabic UIs for mobile and tablet PCs and to thoroughly understand the limitations of designing Arabic interfaces for mobile tablet PCs.

3.3.4. Consensus (Round One). The responses to the first round were managed by grouping them by the similarity of responses. This grouping also enhanced the quality of the guidelines. During round one, the experts answered fifteen questions (queries), twelve of which were related to the UI preferences. For example, the font type guideline was queried as follows:

  (i) Do you think that the (font type) guideline is useful to use?

 (ii) Please rate the (font type) guideline from 1 to 10.

(iii) The remaining three questions asked the experts to evaluate the guidelines in general and provide further comments.

(iv) What features should be added to improve the UI preference guidelines?

 (v) In general, how do you evaluate the religious guidelines and design principles?

(vi) Is there anything you would like to add?

The experts also identified a number of problems in each section. Their responses were important for developing the UI guidelines for Arabic users. Experts clearly expressed their positive impressions of the first version but suggested

various improvements that were very important in developing our targeted guidelines (the details are given in Table 3).

In the last five questions of Round one, the experts were asked to assess the draft version of the guidelines. Participants' satisfaction with the guidelines is summarised in Figure 3.

3.3.5. Consensus (Round Two). All participants in round one replied and participated in the second round. Based on the previous comments and suggestions from the expert panels, we improved the consistency of the guidelines and included more examples and explanations. In particular, the problems identified by the experts in Round one were addressed in the improved guidelines. Table 4 shows the seven sections of the new guidelines:

  (i) An introduction was added.

 (ii) The new section "Why you need to use this guideline" justifies the importance of principles and guidelines in the design of UIs, especially Arabic UIs.

(iii) The touch gesture reference guide compiles touch resources for designers and developers.

(iv) The new section "Terminology definition" clarifies some terminologies in usability and interface design, which confused the designers and developers in Round one.

In round two of the Delphi study, we assessed experts' satisfaction with the amended version of the guidelines. We asked the experts whether the new guidelines integrated the required modifications. The results showed that all experts on the panel were satisfied with the amended version of the new guidelines and agreed that the new version covers most of the required modifications. The results of Round two also

TABLE 3: Example of Summary for the experts' suggestions in Round One of the Delphi study.

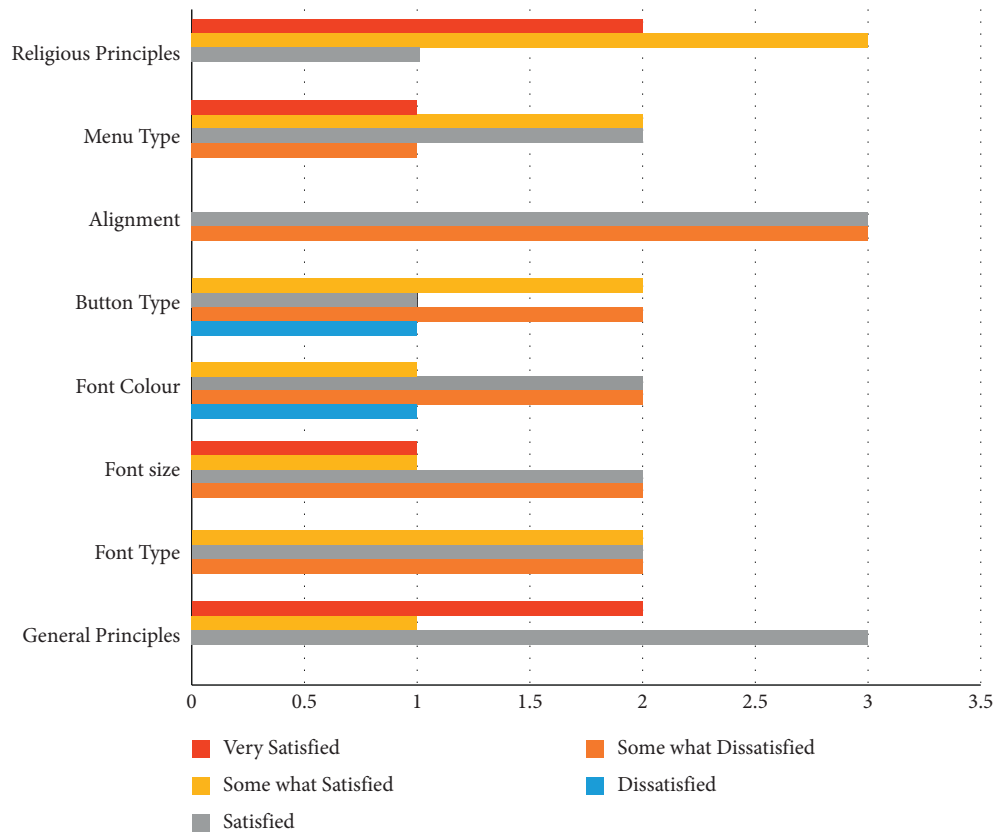| UI element	Delphi study main highlighted result
General issues	The guideline still needs to expand to cover more aspects regarding the interface design, and some points need more clarification. "I prefer if you add more about usability and user experience" Wordy and needs to have some examples to clarify some points. The guideline was integrated with UI guidelines such as Google and apple. This guideline is based on a real user experiment, which makes it more credible and designers can trust it. I think it is good to start to have end-user preferences, but it is hard to generalise." The general principles are more useful but need more examples and figures Designers notice the importance of usability testing and involving the user in their design.
General principles	Experts shared their thought about general principles; the following are the important points that experts mentioned for improving these principles. Principles are more useful for example. "Could you provide some examples and photos to clear your idea?" Some of these principles need clarification. I prefer to rephrase again

Font type and size:	Microsoft products are well-known in the Arabic world and most people are familiar with Microsoft applications. Therefore, experts think users will be more comfortable with simplified Arabic and Microsoft sans serif fonts. "I think the font you selected is perfect and I would appreciate it if you include more fonts next time." "Female user: a feminine design was more appealing, more effective, and better suited for the purpose. Font type could be flexible to the user so that the user can change the fonts anytime he or she prefers. Most Arabic letters take more space than the other script. Therefore, we usually change the font type from serif to new roman and we change the font size from 10 to 13 points. Also, we set the font weight to be thicker than the Latin script as shown in the following code:
	
	EN :
	Span
	{
	font-family: Arial, Serif;
	font-size: 10px;
	font-weight: 100;
	}
	
	AR :
	Span
	{
	font-family:Verdana,Times New Roman (Arabic), Arial Unicode MS,Arial,Transparent,Sans Serif,Verdana, Helvetica;
	font-size: 13px;
	font-weight:600;
	}

Colours:	Colours are one of the important preferences for the user to enhance the usability of any application. The educational application should have cold colours to improve readability. Some experts thought colours are subjective and not easy to choose. Therefore, the design could be something general, not very specific; for example, the female user prefers cold colours and the male prefers warm colours. "Colours are always a problem for me, well I cannot determine the appropriate colours. However, could you add more about colours and colour plate in Arabic, please?" Experts mentioned that the guidelines do not cover user disability problems. Experts believed that the guidelines could consider the device resolution, which affects the used colour. Because some colours will not appear as they are supposed to, due to the device resolution.
Alignment	Alignment is one of the complicated things in the Arabic user interface design with bilingual design; users still suffer when using the Arabic language with English while writing, in addition to sorting the pages with multimedia. Experts were asked to explain more about a text with multiparagraphs and each paragraph containing multilines. Experts thought guidelines should consider a case where text was mixed with images and was bilingual.

Menu type	Regards to the menu text size and style, most of the Arabic letters are larger than the Latin letters, such as the Arabic letter "(س) sein" in comparison with the letter "T", this could affect the menu or button spaces. To solve this problem, we used the following code
	
	EN:
	Menu: link
	{
	font-family: MS Sans Serif;
	font-size:10px;
	}
	
	AN:
	Menu: link
	{
	font-family: Times New Roman (Arabic), Sans Serif;
	font-size:12px;
	}

Religious symbol	Need to consider other religions' signs. "if you can add more and find out about religious symbols' meaning." Collect all the religious symbols' meanings (make it a table).
Touchscreen gesture	Another added that they would appreciate touchscreen gesture explanations with some examples supported by photographs. "Touchscreen design is deferent in regard the designer should taking into his account the gesture and how users could they use their hands (figures)" (P#8).

FIGURE 3: Satisfaction scores of experts during round two of the Delphi study.

TABLE 4: The fina version of the Arabic UI guidelines.

No	UI guideline key components (table of content)	Explanation	Source
1	Introduction	Introduce the work	Author
2	Why we need this UI guideline	Explain why the UI guideline is important for jordanian designers and developers	Author
3	General principles	UI design principles for Arabic tablet PC UI	Literature + students
4	UI preferences guideline (font type, font size, font colour, button types, alignment, menu Types)	The end user (students) UI elements preferences	Students
5	Religious UI guideline	Religious design advice + table of symbol meaning	Literature + students
6	Touch gesture reference guide	Basic gestures for most touch commands	Literature
7	Terminology definition	Explain some design concepts	Literature

confirmed that the experts were satisfied with the new version of the guidelines. When asked to rate the new version of the guidelines, the experts were provided with five feedback evaluation questions, each evaluated on a five-point Likert scale (1 = dissatisfied, 2 = somewhat satisfied, 3 = satisfied, 4 = somewhat satisfied, and 5 = very satisfied). The experts were more satisfied with the new UI guidelines than the initial guidelines. As shown in Figure 3, the designers were satisfied with all aspects of the revised guidelines.

4. Discussion

The UI guidelines generated are intended to unify the design elements and help Arabic UI practitioners with their new designs. Consistency among the UI design

elements is important because it instills trust between users and the application [30]. The evaluated guidelines could be converted into design rules that designers of Arabic interfaces could adapt when designing future applications. The proposed UI design guidelines for Jordanian companies could support and enhance the design of tablet PC applications in the Arabic context. It is assumed that when a company utilises a guideline as a core reference, a large amount of information is systematically arranged to enable several UI problems (such as consistency and user preference) to be solved concurrently. This is because designing an Arabic tablet PC or mobile application demands a solid understanding of all requirements that guarantee the success of the designed application. If the application fails to satisfy the end users, it could likely fail altogether. Therefore, the designers

should understand the users' preferences and establish design rules that are compatible with the particular requirements of each application. Accordingly, not all the proposed guidelines for Arabic UIs are functional for designing a particular Arabic tablet PC application. Therefore, designers and developers are responsible for selecting the UI guidelines that form the specific design rules for a given application. The UI guidelines will also reduce the time (and hence the cost) of development, which is important from a practical perspective [31]. The proposed guidelines could free designers from time-consuming mundane design processes, thereby improving the quality of Arabic user interfaces and the user experiences for Arabic users.

In the Arabic world, the connection between designers and engineers is a critical goal in the product development process of all companies. Therefore, the Arabic UI guidelines offered in this research could encourage designers and developers to disseminate new ideas regarding Arabic user preferences. Companies might also support their design teams with training and additional workshops on how and when to use the UI guidelines. Moreover, these guidelines provide a shared communication language among the designers and the developers, allowing them to share their experiences and thereby link the design and development stages. This sharing could hasten the development time and maintain harmony between the code and the design of overall tablet PC applications, which will strengthen the UI usability of these applications.

5. Summary

The purpose of this study was to refine and evaluate the first version of Arabic UI guidelines; we reported the results of a Delphi study to enhance the quality of the proposed Arabic UI guidelines for tablet PCs. In Round one of the studies, Jordanian experts shared their thoughts and knowledge and accordingly rewrote our guidelines. In Round two of the Delphi study, the experts checked whether their requested amendments had been fulfilled and evaluated the new version of the guidelines. Initial responses indicate that the guidelines will assist software companies to improve their productivity and enhancing their UIs for Arabic mobile and tablet PC applications in educational settings. It is hoped that this work will encourage Arabic UI designers to design more suitable educational applications for tablet PCs for Arabic users.

Data Availability

The underlying experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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