HCI-Based Guidelines for Electronic and Mobile Learning for Arabic Speaking Users: Do They Effectively Exist?

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Abstract. Electronic and mobile learning in recent years has been considered as an invaluable tool to support the learning process. Several tools and comprehensive platforms have been developed in the paradigms of e-learning and m-learning. One issue is the usability of these tools. It is essential to define metrics to measure efficiency, learnability, satisfaction and other usability properties. Another equally important issue is the presence of guidelines compiled based on accumulated scientific reasoning behind design decisions. In this paper, we discuss the issue of HCI-based guideline specific to designing e- and m-learning platforms and tools intended for Arabic users. We present our analysis on the availability of such guidelines, their deployment and to whether they adequately address the challenges characteristic to Arabic language.

Keywords: HCI, Arabic, E-Learning, M-Learning, Guidelines.

1   Introduction

The teaching methods at universities and educational institutions in the Arab world are still dominated by delivering education using the traditional knowledge delivery model. However, there are strong evidences that this is about to change especially with (i) the convenience and affordability of the Internet; and (ii) the popularity of recent advancement and development in distance learning (e.g. MOOCs) which has been attracting attentions in the Arab region. We believe the next few years will witness a rapid growth in interest in technologies to compliment, and maybe is some cases replace, traditional knowledge delivery systems. As a result, Arabic electronic and mobile learning (e- and m-learning) tools and platforms have been increasingly researched. There have been surging interests in Arabic digital content, an important component in learning systems. This is inferred from the number of initiatives, dedicated fund and research work concerning enriching and enhancing this content. Another equally important component is the interaction with these content. In the traditional setting, it is instructors and the educational tools they are using. In technology based learning, it is the user interface layer. The satisfaction in using the e- and m-learning tools and platforms is certainly dependent on, and influenced by,

this interaction layer. Certainly, there is a common agreement that "The learning effectiveness and interface design are substantially intertwined" [1].

The paper explores and presents the challenges of interacting with e- and m-learning platforms. Such interaction can take place during the process of either authoring Arabic content or using the platform's interface by the students. In addition, we identify and report on other challenges that might be faced in terms of developing an e- or m-learning software application. The challenges identified should be carefully considered by software engineers as well as interaction designers in the early stages of the software life cycle. As a result, unpredictable software risks could be minimized. Moreover, interested researchers and practitioners could benefit from the identification of these challenges in opening the directions for future research studies and investigations that could address each of the challenges. Understanding these challenges can help in compiling user interface guidelines, important HCI tools drafted to help in improving user experience, designing high quality user interface and making application interfaces more intuitive. Some research questions can be identified with this regards including: (i) do current and widely used e- and m-learning tools and platforms targeting Arabic users employ guidelines; (ii) how effective are these guidelines if this is the case; and (iii) do these guideline adequately address the challenges characteristic to Arabic language.

In this paper, we attempt to address these research questions. We provide discussion of the main challenges presented by cultural issues as well as language issues specific to the Arab region when designing interfaces. We survey existing guidelines and study the logic behind them and map these guidelines to the identified challenges to evaluate adequacy and applicability. To validate our study we use the survey of Arabic e- and m-learning platforms and explore examples that demonstrate and evaluate some aspects of them against the guidelines/challenges analysis.

The paper, in its remaining part, is organized as follows. In Section 2, we discuss Arabic support in the e- and m-learning platform based on four metrics. In Section 3, we identify challenges of developing user interfaces specific to Arabic users. A survey of existing work related to guidelines and recommendations to address the identified challenges is presented in Section 4. Moreover, in Section 4 we discuss the mapping of the identified challenges against the explored guidelines. The paper is concluded in Section 5.

2   Arabic Support in E- and M-Learning Platforms

Several tools and comprehensive platforms have been developed in the paradigms of e- and m-learning. Only few, however, are targeted to support the Arabic language. In this section, we present a detailed view of some of the widely used e- and m-learning proprietary as well as open-source platforms, including Aplia, Articulate, Atutor, Blackboard, Captivate, Claroline, Desire2Learn, E-College, HotChalk, LearnMate, Moodle, OUCampus, Sakai, and SlideWiki. Our focus has been to survey these platforms in terms of supporting the Arabic language. In particular, we have based our survey on four metrics, namely: (i) interface, (ii) content authoring, (iii) language

processing, and (iv) cost. The objective of this detailed survey is to allow interested stakeholders to be aware of the current status and trends of the most popular e- and m-learning platforms in supporting the Arabic language. We believe that this survey, in turn, should provide decision makers of institutions in Arab countries with useful insights that support their decisions in considering e- and m-learning platforms.

2.1   Metrics of the Survey

In our survey, we have focused on four metrics that can be clearly identified in e- and m-learning platforms in terms of the Arabic language support. The first metric is the interfaces, in which we report on whether the surveyed platform supports Arabic in its interface or not. A platform that does not support Arabic in its interface layout and widgets would not be considered by educators looking for a completely Arabic platform or those looking to deliver education to Arabic speakers. In fact, in his book [2], Nielsen has stated that the ideal international user interface should be available in the user's preferred language. Translating words to Arabic is not the only concern here, right-to-left design, for example, should be considered as well.

The second metric studied in the survey is the content authoring. This is also an important metric as it provides instructors with an overview of the platform's ability to create Arabic content. Content authoring could be in the form of textbooks, discussion forums, comments, presentations, assignments, or questions.

For the third metric, language processing, we aimed at studying the platform's support of natural language processing for Arabic. Over the last few years, several investigations have been conducted to study the challenges of Arabic natural language processing [3]. Natural language processing has been identified as an important element of e- and m-learning platforms [4], [5], as it provides the platform with the capabilities of word and phrase searching, indexing, voice recognition, text recognition, text-to-speech, and auto-grading.

The cost is the last, but not least, metric that has been considered in the survey. We believe that cost is a challenge to many institutions in general and the Arab world in particular. Countries in the Arab region vary in terms of the budgets dedicated to e-learning systems and infrastructures from millions of dollars in the Arab Gulf to almost only in concepts in Sudan and Yemen [6]. Therefore, the cost of the platform is still an issue for many Arab institutions. The focus in the survey has not been on the exact cost of the platform. Rather, the cost has been categorized into: open-source (no cost), cost on students, and cost on educators (instructor or institution).

2.2   Survey Results and Discussion

Table 1 shows a summary of the results of the survey. It is important to mention here that the findings of this survey are the results of deep searching through the official websites of the platforms and up to the date in which this paper has been written. The table shows each platform along with the four metrics discussed in the previous subsection. As Table 1 depicts, Arabic support in the current e- and m-learning platforms is still challenging and immature. In terms of the user interface, several platforms

have supported, or recently started to support, Arabic language. However, most of the support comes in the form of only translating words and dictionaries. Much more have to be done here, such as supporting right-to-left interfaces, layout mirroring, using Arabic dates, time, first day of the week, etc. Section 3 of this paper introduces an in-deep discussion of the HCI challenges and guidelines of building the e- and m-learning platforms. Although most of the surveyed platforms support authoring Arabic content, the same challenge is found here in terms of the need to not only translate or write in Arabic, but also to change many of the content elements stated earlier and explained later. Furthermore, Arabic natural language processing was not found in any of the surveyed platforms except for very basic searching for words, which might be done using third-party engines. This, however, was not considered a clear natural language processing that can be further used in auto-grading or voice recognition for example. Moreover, Table 1 shows how the costs of the platforms vary from cost on educators and institutions, through cost per course on students, to open-source. Open-source solutions provide an opportunity for institution with low-budgets assigned for e- and m-learning to consider such platforms.

Table 1. Arabic Support in E- and M-Learning Platforms

Platform	Interfaces	Authoring	Processing	Cost
Aplia	No	No	No	Students
Articulate	No	No	No	Educators
Atutor	Translation	Yes	No	Open-Source
Blackboard	Translation	Yes	No	Educators
Captivate	No	Yes	No	Educators
Claroline	Translation	Yes	No	Open-Source
Desire2Learn	Locales	Yes	No	Educators
E-College	No	No	No	Educators
HotChalk	Translation	Yes	No	Educators
LearnMate	Translation	Yes	No	Educators
Moodle	Locales	Yes	No	Open-Source
OUCampus	Locales	Yes	No	Educators
Sakai	Locales	Yes	No	Open-Source
SlideWiki	Translation	Yes	No	Open-Source

3   HCI-Based Challenges of Developing and Using E-Learning and M-Learning Platforms for Arabic Speaking Users

This section explores and presents the challenges of interacting with e-learning and m-learning platforms. Such interaction can take place during the process of either authoring Arabic content or using the platform's interface by the instructors and students. In addition, we identify and report on other challenges that might be faced in terms of developing an e- or m-learning software application.

3.1   Language Translation and Cultural Identities

The first and foremost challenge is the identity and localization of the language and culture. The solution here would not be through only translating words. Rather, a complete study of the Arabic culture should be considered and further explored. Digital calendars, for example, should be customized to allow for changing the start of the week as most of the Arabic countries start their weeks on Sunday. In fact, Lebanon, Morocco, and Tunisia are the only Arab countries to start their week on Monday. In addition, Saudi Arabia officially uses Umm-al-Qura calendar, which is based on the Hijri calendar instead of the Gregorian calendar [7]. Moreover, many Arab countries use the Hijri calendar as well in calculating religious holidays.

Translation of words is not a straight forward approach either. Some commonly used words in English user interfaces, for example, are not simply translated into Arabic, such as the word 'Home'. Furthermore, some Arabic words can be confusing when translated; the word "تقويم", for example, could mean either a 'Calendar' or a 'Correction', it could be also confused to mean "Assessment". Another example is in the words 'design' and 'layout', which are translated to mean one word: 'design'. Also, 'Wi-Fi' is not translated in Apple iOS 7 nor in Android Jellybeans, as seen in Fig. 1 and Fig. 2.
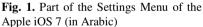
Fig. 1. Part of the Settings Menu of the Apple iOS 7 (in Arabic)

Fig. 2. Part of the Settings Menu of the Android Jellybean 4.1.2 (in Arabic)

In addition, "Bluetooth" is not translated in Apple iOS, and only its transliteration is used in Android Jellybean. The figures also show how the 'Settings' menu title is translated inconsistently in the two operating systems.

3.2   Arabic Numerals vs. Eastern Arabic Numerals

Although Arabic sentences are read from right to left, its numbers are read from left to right. This would raise the challenge of voice recognition of Arabic sentences that include numbers as well as text-to-speech features. In fact, the Hindu numerals, also called the Eastern Arabic numerals, are used in most of the Arab countries as opposed to the Arabic numerals used in Europe and America; Glyphs are different, and

thus, finger gestures should be updated accordingly in case a touch screen system is being used.

3.3   Arabic Natural Language Processing

The nature of the Arabic language has imposed many challenges in terms of the language processing. For example, prefixes, suffixes, and pronouns in Arabic are attached to the same word making a new word, which would be challenging to process. The authors in [3] have identified and described several challenges and suggested some solutions to guide interested researchers and practitioners working on Arabic natural language processing. Several other research studies have been conducted to further explore the challenges of the Arabic natural language processing and suggest usable solutions, such as in [8] and [9].

3.4   Inconsistent Keyboard Layouts

It is essential to have consistency words, situations, or actions in any one user interface. In fact, Nelsen has indicated that consistency is one of the ten usability heuristics for user interface design [10]. However, current versions of Arabic keypad layouts are not consistent. For example, the IBM Desktop Arabic keyboard layout, shown in Fig. 2, is not consistent with the layout of the Mac Desktop Arabic keyboard layout, shown in Fig. 3. This is clearly a challenge to consider in e-learning platforms where students, for example, have inconsistent layouts.

3.5   Arabic Support in Mobile Operating Systems

Although Arabic has been well supported in desktop operating systems, several mobile operating systems have only recently started supporting Arabic. Table 2 shows a summary of the Arabic support in the currently most used operating systems of smart phones [11], [12], and [13]. Furthermore, Arabic support in these operating systems is still limited to right-to-left designs, auto-layouts, or layout mirroring. Apple Siri and Samsung S-Voice, for example, do not support Arabic yet.

Fig. 3. IBM Desktop Arabic Keyboard Layout (*Courtesy of Wikimedia Commons*)

Fig. 4. Mac Desktop Arabic Keyboard Layout (*Courtesy of Wikimedia Commons*)

Table 2. Arabic Support in Mobile Operating Systems

Operating System	Version Suporting Arabic	Date of Release
Windows Phone	Windows Phone 8	October 2012
iOS	iOS 6.0	September 2012
Android	Android 4.2	October 2012

3.6   User Interface Design: Typography

An important element of user interface design in general, and in e- and m-learning platforms in particular is the typography. Although some operating system vendors, such as Microsoft [14] and Google [15], have identified a specific font to be used for Arabic content, many other typography guidelines for Arabic have to be explored as well. This includes the typeface itself, its size, its weight, leading, kerning, tracking, and other guidelines that could be specific to the Arabic language.

3.7   User Interface Design: Color

Color is another issue of the user interface design that could effectively affect the usability of an e- and m-learning platform designed for Arabic users. Color should be further explored in its application to the Arab culture in terms of color interpretation, color accessibility, color themes, and color meanings. In fact, color interpretation is usually dependent on the cultural background of the user [16].

3.8   User Interface Design: Other Visual Design

Another challenge that can be identified is the lack of recent investigations and guidelines that are specifically studied for Arabic user interfaces. Such as dialog boxes, icons, menus, cursors, buttons, error messages, etc. An exploration of Arabic graphical user interfaces has been published in [17], which is old in comparison with the current graphical user interface guidelines and it lacks a study of the visual design elements specific to Arabic interfaces.

4   HCI-Based Guidelines for Arabic Speaking Users: Analysis

Guidelines are generally considered as some rules and recommendations that need to be followed in order to satisfy some usability properties. They usually address issues such as platform characteristics, main user interface principles, design strategies, user interface element usage, and the design of user interface assets among other things. We made a survey of research efforts that have addressed or discussed the challenges we presented in Section 3. Table 3 maps these challenges to the related research, and in some cases technical, work found in the literature.

Table 3. Identified Challenges vs. Available Guidelines

Challenge	Availabe Guidelines
1. Language Translation and Cultural Identities	[17], [18], [19], [20], [21]
2. Arabic Numerals vs. Eastern Arabic Numerals	[17], [19]
3. Arabic Natural Language Processing	[3], [8], [9]
4. Inconsistent Keyboard Layouts	[17], [20]
5. Arabic Support in Mobile Operating Systems	[11], [12], [13]
6. User Interface Design: Typography	[17], [18], [21]
7. User Interface Design: Color	[19]
8. User Interface Design: Other Visual Design	[19], [20], [21]

As stated earlier, the author in [17] explored the Arabization of graphical user interfaces in terms of localization, culture, characters fonts, numerals, etc. The publication, however, is relatively old in comparison with the current graphical user interface guidelines. Another example of a relatively old publication that explored the basic requirements for a UNIX Arabic graphical user interfaces is [20]. In this paper, the authors presented the requirements in terms of the Arabic characteristics, graphical components, graphical tools, and dictionaries. In [19], the authors presented their insights and strategies of a case study in which a team, mostly of non-Arabic speakers, worked on designing an Arabic user experience. The focus was on translation, information architecture, and visual design. Although the authors listed the results of end users of the developed application in the form of bulleted points, details about the usability study were not presented.

We stress the fact that related work listed in Table 3 may not qualify as a comprehensive and evidence based guidelines. Some of the work (e.g., [19], [20], and [21]) can be considered as a technical document compiled by programming languages experts. They are mainly intended for those developers who need to do customization and localization specific programming language products. On the other hand, we found that some work (e.g., [18], [22], and [23]) has included a sound usability testing to justify through experiments their proposed guidelines. Though, their analysis was targeting certain age group and cannot be generalized.

There are some reported work that addressed challenges and issue when developing user interfaces for e- and m-learning tools. As a result, guidelines and recommendations have been proposed. However, the mapped guidelines partially, and often do

not, cover all the aspects needed to adequately address identified challenge. We believe that for those guidelines and recommendations to be effective, they need to be based on a thorough evidence-based analysis and well-planned usability evaluation. This is not the case in most reviewed work as it mainly relies on expert reviews.

Another aspect is that Arabic users are spread across a wide region and across many countries. Naturally, this means there are many dialects spoken. We estimate that there approximately 13-15 Arabic dialects that vary, to some extent, from one another. Currently, majority of interfaces are in formal modern standard Arabic. Little research have been addressing and scientifically justifying whether the use of standard Arabic is satisfying the entire Arabic users. Similar issue can be found in Wikipedia with content in both standard Arabic and dialects are available. We believe more research is needed with this regards. The issue of bilingualism among Arab users is a major issue. Many terms that are being used are not Arabic. For example, many French terms are used in countries like Morocco and Algeria while English words are used in countries like Jordan and Egypt. No properly compiled recommendations exist on how to handle this issue.

We can therefor argue that most available Arabic specific guidelines to ensure usable and effective interface layers do not exist and are not sufficient to address most language specific challenges. Many design decisions are made based on recommendations from experts and users that are rather subjective and cannot be considered as generalizations. There is a pressing need for research efforts to scientifically validate existing guidelines and compile challenge-based guidelines to enhance and maximize user experience.

5   Conclusion

In this paper, we discussed the topic of usability issues for e- and m-learning tools and platforms for Arabic speaking users. Currently, this topic is gaining momentum with the increasing demands for such tools to support the educational process in schools and universities. We surveyed popular tools in terms of Arabic support and we presented main challenges that need to be addressed in such tools. Based on the challenges we discussed, we provided a preliminary survey of related research and technical works and provided some sort of recommendations to address these challenges. We concluded based on our analysis that existing guidelines do not adequately address the pressing challenges designers and developers are facing when dealing with usability issues in the user interface layers of e- and m-learning tools and packages.

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