A Framework for the Development of Localised Web Accessibility Guidelines for University Websites in Saudi Arabia

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Abstract. The number of universities in Saudi Arabia has increased dramatically in the last two decades. As a result the number of their websites has also increased without any clear guidelines regarding accessibility, which may hinder some of their disabled users from benefiting from their content. Internationally, a number of initiatives have been implemented to develop guidelines for web accessibility such as WCAG to overcome this problem. However, these guidelines are developed in Western countries and applying them to Arabic websites can raise more accessibility issues, for example related to culture and language. In order to enhance the accessibility of Saudi university websites, a new framework for the development of localised web accessibility guidelines is presented in this paper. In addition, an evaluation process to validate the framework is described.

Keywords: Web accessibility · Disability · Localised guidelines · University websites · Saudi Arabia

1 Introduction

In recent years, the number of people using the Internet in Saudi Arabia has been increasing dramatically from 200,000 in 2000 to 18,300,000 in 2014 [1] which indicates that 65.9 % of the population of Saudi Arabia uses the Internet. However, the subject of web accessibility has remained a problematic issue for Arabic language websites in terms of accurately assessing whether those with disabilities are able to enjoy their use on equal terms with their peers [2–4]. This is despite the fact that by 2015[1], there were over 700 thousand disabled individuals in Saudi Arabia representing almost 8 % of the total population.

Without suitable web accessibility guidelines and standards the number of people excluded from obtaining the benefits of accessing the web would definitely increase. This is an important issue that needs to be taken into account when developing sites, services and content. A number of initiatives have been implemented to develop guidelines for web accessibility including the Web Accessibility Initiative Web Content Accessibility Guidelines (WCAG 1.0) which were published in 1999 [5]. These guidelines were

[1] http://rs.ksu.edu.sa/82739.html.

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revised and became WCAG 2.0 in 2008. At that time, WCAG was internationally known and respected as a 'de facto' standard for Web accessibility [6]. In 2012, WCAG 2.0 finally became an international standard called (ISO/IEC 40500:2012) [7].

Web accessibility guidelines that are developed in Western countries (North America and Western Europe) are followed by some Arabic developers when designing and developing Arabic websites [2–4]. However, some of the success criteria, as part of the guidelines, do not fit all cultures and all languages; a simple example of this is the font size and type. The acceptable font size and type in Latin-based languages would not be accepted in other languages like Arabic, where larger fonts are required for ease of reading. Some symbols are strongly culture-defined because what they represent is not available in another country. Using inappropriate symbols that the user cannot recognise or with which they do not identify reduces the accessibility of the web product. Moreover, the use of certain symbols, icons, or images may be offensive or even against the law in some countries. According to [8], Saudi users prefer to have more images and less text compared to Western countries where there tends to be a preference for more text and fewer images, which can raise a further problem when surfing the web as the Internet speed in the country can be slow and unsatisfactory.

Due to the fact that some people in Saudi Arabia do not listen to music and believe it is forbidden from a religious point of view depending on how conservative they are, if a Saudi user navigates a website that presents a video with music in the background, for example, he might not continue watching it and consequently quit the website. Although, this is not the case for all Arab users, as they differ in their beliefs and traditions, an appropriate way to deal with such a situation is needed, and this is not found in the existing guidelines. So, besides providing text alternatives for the video, the developers would provide a hint for people that there is music in the video, and/or providing another version of the video without music if they prefer no music.

Cloning the WCAG 2.0 guidelines and applying them to Arabic websites would raise more accessibility issues and require different success criteria and possibly even techniques to maintain accessibility levels. This problem has been recognised by a number of researchers, as they recommend adapting the guidelines to the Arabic context [3].

In this paper, related work is discussed in Sect. 2. A new framework for the development of localised web accessibility guidelines for university websites in Saudi Arabia is presented in Sect. 3. Section 4 explains the validation process for the proposed framework. Section 5 discusses the results from the validation process. Section 6 presents the confirmed framework. Finally, Sect. 7 concludes with a summary of the paper.

2 Related Work

Studies on web accessibility in the Arab world started a decade ago when [9] conducted their study on e-government websites in Saudi Arabia and Oman. Since then, there has been limited research to examine web accessibility of Arabic websites, such as [4, 10, 11]. There has been an agreement on the low level of web accessibility in Arab countries and a lack of awareness of its importance. In addition, the localisation to the Arab world and its impact on accessibility have not been investigated by these studies.

Nevertheless, there have been efforts made by different bodies to improve the status of web accessibility in this region. For example, the translation of web accessibility guidelines (WCAG 2.0) into Arabic[2] with the aim of providing better understanding of the them by Arabic native speaker developers. It should be noted that this initiative has a number of weaknesses such as incomplete and inconsistent translation and the use of unfamiliar and inaccurate Arabic words. There appears to have been little effort to understand the Arab people as a target audience, with a lack of localisation of examples within the guidelines. More work is needed in this field to serve the Arab world and this research aims to address the gap.

3 Constructing a New Framework for the Development of Localised Web Accessibility Guidelines for University Websites in Saudi Arabia

In order to construct the framework for the development of localised web accessibility guidelines for university websites in Saudi Arabia, several research areas have been investigated. Each area has an influence on how the framework is constructed. These areas include: web accessibility as the main context, with different guidelines that contribute to accessibility, and also cultural, technical and financial aspects and their impact on accessibility guidelines.

The framework has been constructed in three main phases. The purpose for the first phase was mainly to determine, from literature, the components and aspects that needed to be considered when localising web accessibility guidelines. This resulted in the identification of seven components. These are web accessibility, cultural markers, genre markers, costs, user diversity, Internet infrastructure and technology variety.

In the second phase, the components and all of their subcomponents and elements identified in Phase One were synthesised to form the framework for localised web accessibility guidelines. As this research investigates the localisation to the Saudi context, some of the identified components in Phase Two needed more specification. Two components were specified in detail in this phase: cultural markers and genre markers. Figure 1 shows the proposed framework with all of its components and subcomponents.

A brief description of the components of the framework is as follows:

3.1 Web Accessibility

Web accessibility is concerned with making websites perceivable, operable, understandable and robust [12]. This means that people with disabilities can perceive, understand, navigate, and interact with the web, and that they can contribute to the web [5].

3.2 Genre Specific Cultural Markers

Genre or knowledge domains refer to information types that are presented on the web and describe large categories of websites [13], for instance, news websites or university

[2] Available on: http://www.alecso.org/wcag2.0.

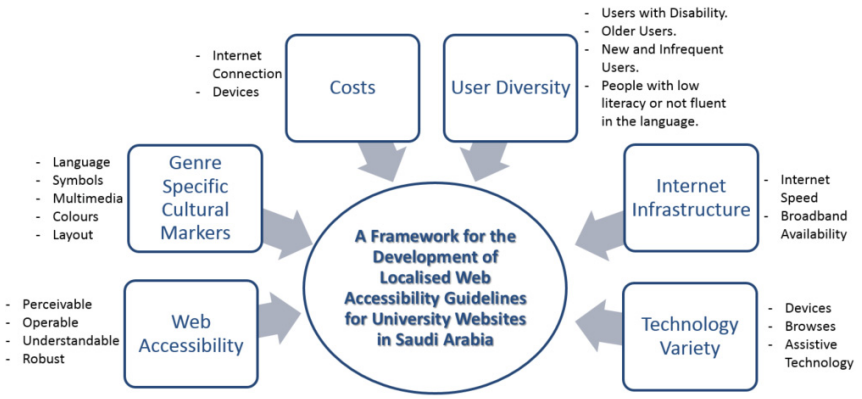

Fig. 1. Proposed framework for the development of localised web accessibility guidelines for university websites in Saudi Arabia.

websites. Cultural markers are interface elements and features that are acceptable and preferred within a particular cultural group [13]. Genre specific cultural markers are elements and features of a specific website genre for a particular cultural group [13].

In the framework, this component contains 5 subcomponents: language, symbols, multimedia, colours and layout. Language comprises 13 elements and multimedia contains 3 elements.

3.3 Costs

Costs of devices and Internet connection could prevent users from accessing the Internet and surfing the Web [14, 15].

3.4 User Diversity

This concerns different users with different abilities, for example: users with disabilities, older users, new and infrequent users and people with low literacy or those not fluent in the language [5, 12].

3.5 Internet Infrastructure

This component comprises two subcomponents that could impact on the ability to connect to the web in a satisfactory manner which may also affect accessibility and personalisation of content: Internet speed and broadband availability in the country [16].

3.6 Technology Variety

Technology variety [17] requires that a broad range of hardware and software are supported. In particular the use of assistive technologies, that are mainly used by people with disabilities, to support functional limitations need to be taken into account.

4 Validating the Framework

Interviews were used to conduct an exploratory study. The interview research method was chosen because it enables in-depth discussion and exploration. Experts were chosen for interview at this exploratory stage to ensure the findings would have more credibility than those from a sample of non-experts [18]. Therefore, the initial framework proposed via a desk-based study was reviewed by interviewing experts developing university websites in Saudi Arabia, or Saudi university researchers working in this area. The process of expert review and validation of the framework is comprised of a number of steps, as shown in Fig. 2:

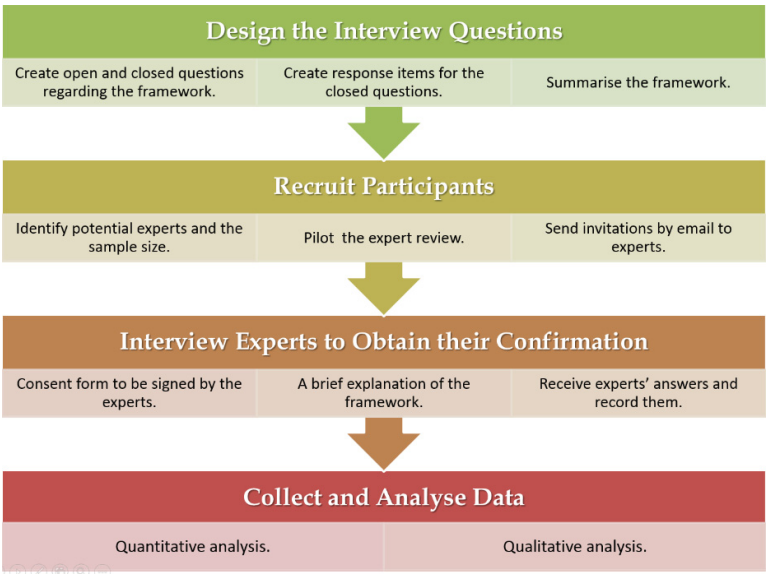

Fig. 2. The process of expert review

4.1 Interview Question Design

The expert review was based on conducting semi-structured interviews with experts. These included both closed and open questions. The closed questions concerned obtaining their opinions on the components and elements of the proposed framework. In addition, the experts were allowed to comment on the proposed components. The open questions aimed to find further components or elements that they recognised but were not identified by the desk-based study.

The Likert scale is a commonly used approach to measure participants' opinions and attitudes regarding a certain statement. Therefore, the closed questions were constructed using a Likert-type scale [19] with the following ratings: strongly disagree = 1; disagree = 2; neutral = 3; agree = 4; and strongly agree = 5. These different ratings are known as Likert items. Table 1 shows the adopted Likert items, their weight and their meaning in the expert review.

Table 1. Likert items with their weight and meaning

Likert item	Weight	Meaning
Strongly disagree	1	This item needs to be excluded from the framework
Disagree	2	This item may need revision or be excluded from the framework
Neutral	3	Exclusion of this item does not affect the framework
Agree	4	This item may need revision to be included in the framework
Strongly agree	5	This item needs to be included in the framework

Since the selected research methods required people as participants, ethical approval to conduct this research was obtained from the University of Southampton (Research Ethics Number 17056). No personal data was collected at this stage; the information collected was anonymised and any identifying information removed.

4.2 Recruiting Participants

Identify Experts and the Sample Size. According to [18], qualitative studies usually depend on non-probability sampling, where participants are chosen according to non-random criteria. When recruiting experts, the choice is based on their knowledge and experience in the area being studied. Therefore, in this type of sampling, sample size depends on saturation [20]. Saturation point is reached when no new knowledge can be gathered, and is usually achieved by 12 interviews [20].

In this expert review, 15 experts from various Saudi universities were interviewed. A person was considered an expert if they had at least two years' experience of university website development in Saudi Arabia or were Saudi university researchers with at least two published papers in this area of research.

Piloting Expert Reviews. Three Saudi web science researchers were selected to pilot the interview questions and the materials presented in the interviews. This was to gather comments and recommendations regarding the questions and other material. Each was met individually, and comments were made. Some questions were recommended to be deleted, and the phrasing of some questions was found to be unclear. After recording their feedback and making the necessary changes, a set of interview questions was created. By the end of the pilot study, the interview questions and other material were ready to be presented to the experts.

An E-mail Invitation to Experts to Participate. After conducting the pilot study, an invitation was sent by email that requested experts' participation. The invitation was in Arabic and included: participant information sheet, approximate duration of the interview and summary description of the framework.

4.3 Interview Experts to Obtain Confirmation

After sending the invitation emails to the experts, 15 of them responded by agreeing to participate and informed us of their preferred way of communication. Appointments

with the experts were made for the three month period of September 2015 to November 2015. The time allocated per expert was between 45 and 60 min. The interviews were conducted face-to-face, over the phone and online, according to the availability and location of each expert.

Most of the experts (12) were developers or designers, and the remaining three were researchers in the area of web accessibility. In each interview, the expert was presented with a consent form to sign and then given a brief explanation of the framework and how to respond to the closed questions. After that, the questions were asked and the responses audio recorded by the researcher, after obtaining permission.

4.4 Collecting and Analysing Data

All the interviews were conducted in Arabic and audio recorded, then transcribed. Afterwards, the transcripts were translated from Arabic to English. Arabic native-speaking researchers at the University of Southampton were able to confirm the accuracy of the translated transcripts.

Quantitative Analysis. To analyse quantitative data statistically, the experts' responses to closed-ended questions were collected and entered into SPSS software. The one sample t-test was used to analyse the results. This helps by comparing the mean of a population (μ) with a hypothesised value ($\mu 0$). The hypothesised mean here: $\mu 0 = 3$ which indicates Neutral on the five point Likert-type scale. In addition, the one sample t-test involves testing the null hypothesis against the alternative hypothesis. By convention, the statistical significance level α was set to 0.05 for a 95 % confidence level. The hypotheses for testing each item in the framework are as follows:

- The null hypothesis (H0): If the mean rating is higher than 3 ($\mu > \mu 0$) in all questions, then the item affects localised web accessibility guidelines and needs to be included in the framework. In this case, H0 is accepted and H1 is rejected.
- The alternative hypothesis (H1): If the mean rating is less than or equal to 3 ($\mu \leq \mu 0$), then the item does not affect localised web accessibility guidelines. In this case, H1 is accepted and H0 is rejected.

Qualitative Analysis. To analyse experts' responses to open questions and their comments on the framework components, the interviews were transcribed and saved into NVivo. NVivo is a software tool used to manage and understand textual data, and make the most of it. Experts' responses were tagged using NVivo according to analysis themes and components, collected together into groups, then synthesised.

5 Results and Findings from the Quantitative and Qualitative Analysis

This section discusses the confirmation of the proposed framework. The results of quantitative analysis of responses to the closed questions are discussed first followed by those of the qualitative analysis to the open questions.

Table 2. Statistical results for closed ended interview questions

Component		No	Question	Sig.	Mean	Accepted Hypothesis
Web Accessibility		1	The content of the website must be: Perceivable, Operable, Understandable and Robust	< 0.001	5.00	Null Hypothesis (H0)
Genre Specific Cultural Markers	Language	2	Direction of reading and writing	0.008	3.93	
		3	Uni-case language	< 0.001	3.73	
		4	Formation of the letters	< 0.001	3.80	
		5	Cursive form and paces within and between words	< 0.001	4.27	
		6	Diacritical Marks	< 0.001	5.00	
		7	Homographic language	< 0.001	4.33	
		8	Gender-specific language	< 0.001	3.93	
		9	Font size	< 0.001	5.00	
		10	Font type	< 0.001	5.00	
		11	Type of text emphasis	< 0.001	5.00	
		12	Alignment of text	< 0.001	4.60	
		13	Long sentences	< 0.001	4.33	
		14	Diglossic language	0.001	4.07	
	Symbols	15	Understood and acceptable symbols within the culture for university websites	< 0.001	4.93	
	Multimedia	16	Multimedia appropriateness to the culture in university websites	< 0.001	4.87	
		17	Incorporating music with multimedia provided on university websites	< 0.001	4.67	
		18	Amount of multimedia preferred in the culture for university websites	< 0.001	4.20	
	Colours	19	Acceptable and preferred colours in the culture for university websites.	< 0.001	4.40	
	Layout	20	Acceptable and preferred layout in the culture for university websites	< 0.001	4.47	
Costs		21	High costs of Internet connection and devices	< 0.001	1.87	Alternative Hypothesis (H1)
User Diversity		22	Various Users: disabled, older, inexperienced users and low literacy or not fluent in the language	< 0.001	4.80	Null Hypothesis (H0)
Internet Infrastructure		23	Internet speed in the country.	< 0.001	4.93	
		24	Broadband availability.	< 0.001	4.87	
Technology Variety		25	Various devices, browsers and assistive technology	< 0.001	4.73	

5.1 Results from Quantitative Analysis

The results of the quantitative analysis of experts' responses are summarised in Table 2. They show that the experts had positive attitudes toward inclusion of almost all the components in the framework, with the exception of Costs (Q21). The means of expert opinion are greater than $\mu 0 = 3$ and the significance value (Sig.) is less than 0.05. Consequently, the null hypothesis is accepted and the alternative hypothesis is rejected for all questions. This indicates that all these components, subcomponents and elements affect localised web accessibility guidelines for Saudi university websites. In contrast, the mean of experts' responses to questions about inclusion or otherwise of Costs in the framework is less than $\mu 0$ ($1.87 < 3$), indicating disagreement. Therefore, the null hypothesis is rejected and the alternative hypothesis is accepted, meaning that this component does not affect localised web accessibility guidelines for Saudi university websites.

5.2 Results from Qualitative Analysis

Experts were asked to identify any other aspects that had not been covered by the proposed framework. Their responses were used to enrich the framework. The following elements were suggested to be added to the subcomponent 'Language':

- Numbers in Arabic websites, as they need to be in one consistent form through the website, whether Arabic or Hindi. (**Expert B**)
- Abbreviations and acronyms in Arabic. Although they are rare, instances occur in Arabic and they do not always use a full stop to discriminate between the abbreviated form of the words and the completed form, which confuses users. (**Expert B**)
- The spacing between lines and paragraphs needs to be more than in English. (**Experts C, D and F**).

Experts N and O suggested web usability as a new component in the framework. They justified this by saying that usable accessibility is important, as the users are involved in the evaluation process. While technical accessibility is evaluated by tools, it does not check for usability for target users.

6 The Framework After Refinement

Based on the experts' responses discussed above, the framework has been refined, as illustrated in Fig. 3. The component of cost has been removed, and web usability has been added to the framework. In addition, subcomponent 'Language' was extended by the following elements: numbers in Arabic websites, abbreviations and acronyms in Arabic and spacing between lines and paragraphs.

This confirmed framework provides the basis for the development of localised guidelines for university websites in Saudi Arabia.

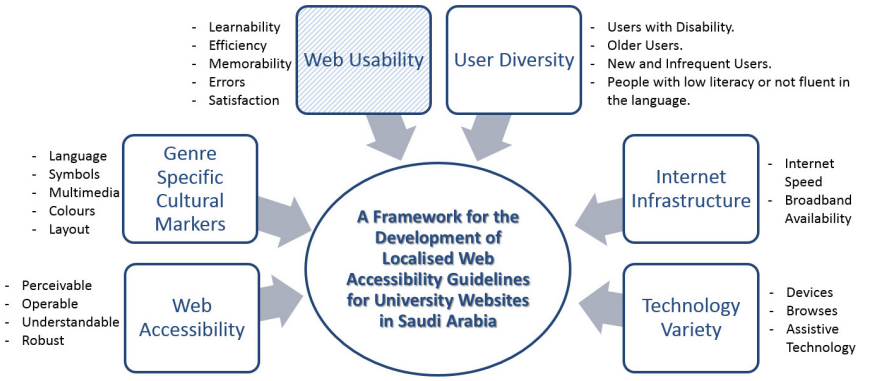

Fig. 3. A framework for the development of localised web accessibility guidelines for university websites in Saudi Arabia - after refinement.

7 Summary and Conclusion

A new confirmed framework for the development of localised web accessibility guidelines for university websites in Saudi Arabia is presented. This paper has described the approach, methods, analysis and results of the experts' evaluation of the components, subcomponents and elements of the proposed framework for localised web accessibility guidelines for Saudi university websites. It has explained the process of expert review as comprising four steps: design interview questions; recruit participants; interview experts; and collect and analyse the data. Open and closed questions have been designed to cover all aspects of the framework. There followed, an expert evaluation study carried out with 15 experts, comprising both web developers and researchers in the area of web accessibility from Saudi universities.

The importance of all components in the proposed framework, apart from one (costs), has been confirmed by the results and findings of the interviews, including their statistically significant results. Furthermore, the framework has been refined by incorporating a new component (web usability). Three new elements emerged from the findings and were added to the 'Language' subcomponent.

The next task will be to develop the localised guidelines. Based on the confirmed framework, the existing WCAG 2.0 guidelines and their success criteria will be divided into two categories: applicable or not applicable to accessibility guidelines for Saudi university websites. Afterwards, additional guidelines that are not identified by WCAG 2.0, but needed for the Saudi websites, will be gathered from the confirmed components. Having completed these tasks, the guidelines will need confirmation from the experts (a group of developers of university websites in Saudi Arabia) in order to ensure they can be applied as techniques that will support WCAG 2.0 success criteria for Arabic websites.

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