USABILITY AND ACCESSIBILITY EVALUATION OF LIBYAN GOVERNMENT WEBSITES

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by

NUHA AWLAD KARAIM

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USABILITY AND ACCESSIBILITY EVALUATION OF LIBYAN GOVERNMENT WEBSITES

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Approval of the Graduate School of Natural and Applied Sciences, Atılım University.

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

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ABSTRACT

USABILITY AND ACCESSIBILITY EVALUATION OF LIBYAN GOVERNMENT WEBSITES

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E-government applications may have benefits for the elderly or people with disabilities in terms of providing them with more effective, efficient and satisfactory services. However, for these citizens to get maximum benefits from government services through e-government applications, usability and accessibility criteria should be met. Despite the recent huge increase in the number of government websites, the poor usability and accessibility characteristics of these websites result in a failure to fulfill citizens' needs and expectations. The aim of this study was to evaluate usability and accessibility of Libyan government websites. Usability evaluation was conducted by recruiting 32 end users with heuristics and accessibility evaluation was performed using automated testing tools. To this end, a total of 10 government websites in Libya were analyzed according to the criteria of the Web Content Accessibility Guidelines (WCAG) 2.0 and one of them was selected for further analysis based on usability criteria. Results of the study showed that Management of Scholarships website had significant number of usability problems. Visibility of system status, user control and freedom, and user help users recognize, diagnose, and recover from errors were the most violated heuristic items. All Libyan government websites did not pass accessibility evaluation, except Management of Scholarships, for AChecker tool, but they all failed in TAW tool. Providing text alternatives for each non-text elements was the most frequently violated success criteria for Libyan government websites.

Keywords: Usability, Accessibility, e-Government, Government Websites, Automation Evaluation Tools, Heuristics Evaluation

ÖZ

LİBYA KAMU WEBSİTELERİNİN KULLANILABİLİRLİK VE ERİŞİLEBİLİRLİK DEĞERLENDİRMESİ

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E-devlet uygulamaları yaşlı ve engelli insalara etkili, verimli ve memnuniyet verici hizmetler sunarak faydalı olabilirler. Ancak, bu kişilerin e-devlet uygulamaları aracılığıyla kamu hizmetlerinden maksimum faydayı alabilmeleri için, kullanılabilirlik ve erişilebilirlik kriterlerini karşılaması gereklidir. Son zamanlarda kamu websitelerinin sayısında görünen büyük artışa rağmen, bu sitelerin kötü kullanılabilirlik ve erişilebilirlik özellikleri sonucunda vatandaşların ihtiyaç ve beklentieri karşılanamamaktadır. Bu çalışmanın amacı da Libya'da bulunan kamu websitelerinin kullanılabilirlik ve erişilebilirliklerini değerlendirmektir. Kullanılabilirlik değerlendirmesi sezgisel üzerinden 32 kullanıcı ile, erişilebilirlik değerlendirmesi ise otomatik değerlendirme araçları ile yapılmıştır. Bu amaçla, 10 kamu websitesi WCAG 2.0 kriterleri doğrultusunda değerlendirilmiş, seçilen bir kamu websitesi ise detaylı olarak kullanılabilirlik kriterlerie göre analiz edilmiştir. Çalışma sonucunda elde edilen bulgulara göre Management of Scholarships websitesinde önemli kullanılabilirlik problemleri tespit edilmiştir. Sistem durumunun görünürlüğü, kullanıcı kontrolü ve özgürlük, ve hataları önleme sezgisel maddeleri en fazla ihlal edilen meddeler olarak belirlenmiştir. Achecker aracı raporuna göre Management of Scholarahips haricindeki tüm Libya kamu websiteleri erişilebilirlik kriterleirni karşılamamışlardır. TAW aracına göre ise tüm websiteler bu açıdan başarısız olmuşlardır. Her bir metin dışı unsur için metin alternatiflerinin sağlanması en fazla ihlal edilen başarı kriteri olarak görülmüştür.

Anahtar Kelimeler: Kullanılabilirlik, Erişilebilirlik, e-Devlet, Kamu Websiteleri, Otomatik Değerlendirme Araçları, Sezgisel Değerlendirme

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To all my family and my friends

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I express sincere appreciation to my supervisor Asst. Prof. Dr. Yavuz Inal for his guidance and insight throughout the research. To my mother, my family and my close friends, I offer sincere thanks for them continuous support and patience during this period.

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CHAPTER 1: INTRODUCTION

Internet technologies have opened a new communication channel for citizens, governments, and businesses, allowing access to information and services in an efficient and effective way. First, private sector companies considered internet technologies as part of the business process and then public and government institutions (Kumar, Mukerji, Butt & Persaud, 2007). In recent years, electronic government (e-government) has emerged as a powerful online platform, which allows the government not only to provide citizens with public services and information but also to interact with them. Furthermore, the e-government platform is used to interact and communicate with businesses from the private sector and other government institutions (Busoud & Zivkovic, 2016).

E-government has become an indicator of being a contemporary society (Al-Khouri, 2013), and is essential for the improvement of government services by allowing the citizens to express their opinions, needs, and expectations from the government. E-government may be considered as a first door to government institutions (Guner & Inal, 2015) in terms of introducing them to all citizens including those with disabilities. Governments also use these applications to raise the awareness of their citizens and inform them about laws and regulations as well as government policies and services (Muir & Oppenheim, 2002). E-government provides several benefits and advantages for citizens (Kumar, Mukerji, Butt & Persaud, 2007; Inal, Ozen-Cinar & Cagiltay, 2016); e.g., citizens can choose their way of interaction with government institutions and obtain services at anytime and anywhere without having to visit a specific government institution.

E-government applications may also have additional benefits for the elderly or people with disabilities in terms of providing them with more effective, efficient and satisfactory services. However, for these citizens to get maximum benefits from government services through e-government applications, usability and accessibility criteria should be met. Despite the recent huge increase in the number of government websites, the poor usability and accessibility characteristics of these websites result in a failure to fulfill citizens' needs and expectations.

In ISO 9241-210, usability is referred to as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use". Nielsen (2012) defines usability by the five quality components of learnability, efficiency, memorability, errors, and satisfaction. Web accessibility concerns "the degree to which a site is accessible to the largest possible range of people" (Latif & Masrek, 2010). ISO 9241-171 defines accessibility as "the usability of a product, service, environment or facility by people with the widest range of capabilities". According to the Web Accessibility Initiative (WAI), "web accessibility means that people with disabilities can use the Web. More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web".

The usability of a website has a direct influence on user satisfaction since when a website is not well-designed, this can prevent users from effectively and efficiently accessing or using the site, and thus, users may not visit the website again (Matera, Rizzo & Carughi, 2006). According to Al-Khalifa (2010), the low level of accessing government websites by citizens might be caused by poor design and usability characteristics and it has also been suggested that citizens find it very difficult to effectively receive services from government websites (Asiimwe & Lim, 2010).

In order to make a website accessible for all people including the elderly and disabled people, modernist approaches should be taken into account during the design and development processes (Abanumy, Al-Badi & Mayhew, 2005). All people should be given the same chance to receive Internet services (Huang, 2003),

thus being inclusive is one of the most significant necessities of government websites. Government should offer accessible services to all their citizens; therefore, their websites should fulfill their citizens' needs and expectations anywhere and at any time (Al-Khalifa, Baazeem, Alamer, 2016; Ismailova & Inal, 2016).

From underdeveloped to developed countries, all governments in the world make investments to make their complex processes and procedures simpler and clearer for their citizens in their interaction and communication through the Internet (Fgee & Alkallas, 2013). Similarly, a few years ago, Libya, as a developing country, started to develop e-government services to offer information and services in an effective and efficient way for its citizens (Busoud & Zivkovic, 2016), but this process is still in the initial phases (Forti, Bechkoum, Turner & Ajit, 2014). According to the United Nations e-Government Survey, Libya ranked 114 out of 184 countries in 2010, 114 out of 190 countries in 2012, 121 out of 193 countries in 2014, and 118 out of 193 countries in the world e-government development index (EGDI) (UN e-Government Survey, 2016). The survey also reported that Libya had been one of the top 10 countries for e-government services in Africa for years. However, the rank of the country based on EGDI has been fluctuating from 2010 to 2016. There have been a number of attempts to improve government websites and e-government services in Libya. However, political and economic issues constitute the two main barriers that obstruct the country's development process (Busoud & Zivkovic, 2016).

Although in the literature, there are a number of studies on e-government applications in Libya (e.g., Kumar, Daeri & Eldresi, 2010; Fgee & Alkallas, 2013; Forti, Bechkoum, Turner & Ajit, 2014; Busoud & Zivkovic, 2016), no research has been undertaken to evaluate the usability and accessibility of the government websites in the country. Therefore, the aim of this study was to perform such an evaluation through two case studies. Usability evaluation was conducted by recruiting 32 end users with heuristics and accessibility evaluation was performed using automated testing tools. To this end, a total of 10 government websites in Libya were analyzed according to the criteria of the Web Content Accessibility Guidelines (WCAG) 2.0 and one of them was selected for further analysis based on usability criteria. By highlighting the problems regarding the usability and

accessibility of the selected websites, this study aims to help government authorities, administrations, and developers to improve their awareness and knowledge about these issues.

Research Questions

The following research questions were formulated for the usability and accessibility evaluation of Libyan government websites:

- What are the main usability problems of the website of Management of Scholarships identified by evaluators?
- Which heuristic items are violated most and least in terms of usability?
- What are the main accessible characteristics of Libyan government websites based on the WCAG 2.0 guidelines?
- To what extent do Libyan government websites violate the accessibility conformance checkpoints?

This master thesis consists of six chapters: The first chapter contains the introduction statements of the thesis. Chapter 2 reviews the literature concerning e-government, usability and accessibility of government websites. This chapter also presents general background information on e-government and its usability and accessibility issues, followed by the current state in Libya. Chapter 3 presents the research methodology used in the current study. In Chapter 4, the results of the collected data are systematically given and in Chapter 5, these results are compared with those reported in similar studies in the literature. Finally, Chapter 6 presents the conclusions and recommendations for future work.

CHAPTER 2: LITERATURE REVIEW

2.1 E-government

Information technologies have changed the world and people's lives by making it easier to access government services. In the last two decades, governments have increased their investment in these technologies to provide more effective services using the Internet compared to conventional techniques (Janowski, Cellary & Davies, 2013). Today, governments are expected to engage in more interaction and communication with their citizens and reach them easily (Kacem, Belkaroui, Jemal, Ghorbel, Faiz & Abid, 2016) using information technologies. As a part of these technologies, e-government aims to efficiently provide information and services for citizens by implementing contemporary technologies that reduce the time and money citizens spend for access to government services (Mahmoodi & Nojedeh, 2016).

E-government is mainly about providing public services through information technologies to clients that are citizens, companies, government employees, and other public government institutions (Fang, 2002). By utilizing information technologies, e-government enhances the effectiveness of government services for all clients (Carter & Bélanger, 2005). Another aim of e-government is to increase the appropriateness, cost-effectiveness and efficiency of these services (Solinthone & Rumyantseva, 2016).

According to Bhatnagar (2002), e-government is a method of presenting necessary information and offering services to national and international audiences. World Bank Website (2005) defines e-government as referring to "the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and

mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government".

Considering the definitions and aims of e-government, it is more than providing information and delivering online services through web pages and electronic mails; it is a result of technological innovations and uprising, which help to improve the information-based community in a country (Almarabeh & AbuAli, 2010). Kacem, Belkaroui, Jemal, Ghorbel, Faiz and Abid (2016) reported that e-government focuses on facilitating appropriate services to people in order to meet their needs and requirements and increase their satisfaction with services. They also give citizens the opportunity to benefit from government services without having to physically visit government institutions within working hours (Kumar, Mukerji, Butt & Persaud, 2007).

All countries, independent of their developmental level, are expected to apply e-government technologies to improve their services and provide their citizens with better opportunities and increase their satisfaction with the government. Libya is a developing country but it has been adopting information technologies over the years to encourage the population to use government services online.

2.2 E-government in Libya

Libya has been investing in e-government technologies to improve the regular business processes of its government institutions in an efficient, effective and satisfactory way for the citizens (Alatrash, Albskri & Boskovic, 2016). The information and communication technology strategy of the Libyan government is based on telecommunications and the country has been implementing stringent controls on digital wireless technologies and related technological innovations to improve motivation, progress and growth (Fgee & Alkallas, 2013).

Libya started to reduce the degree of centralization of services by starting with e-government projects in order to offer digital information and services to people, companies, and other government institutions (Forti, Bechkoum, Turner & Ajit, 2014). With the aim to foster economic solidity to have powerful organizations in the

country, the government has developed many websites to simplify services and interactions with the citizens; however, transition to e-government still faces some problems that are inherited from political insecurity (Busoud & Zivkovic, 2016).

Although Libya has a number of critical problems caused by previous governments and current issues regarding political, social and economic improvements, the country has established significant websites and initiated important digital projects (Busoud & Zivkovic, 2016). It is important to note that 70% of the Libyan ministry websites provide information about their work using Internet technologies (Ahmed, Mehdi, Moreton & Elmaghraby, 2013). However, Libya is still in the early stages of providing digital information and services in terms of the information uploaded on some of the main government websites (Kumar, Daeri, & Eldresi, 2010).

The Libyan government seeks to eliminate the cultural and geographical barriers between central cities by delivering essential services and information via e-government websites (Busoud & Zivkovic, 2016). However, Libya should continue to work on the implications of e-government and invest in digital public services to manage the government processes through Internet technologies (Ahmed, Mehdi, Moreton & Elmaghraby, 2013).

Citizens get better services using e-government technologies without facing any limitations in terms of time and physical locations, but all the information and services should be made accessible and easy to use for citizens to properly meet their needs (Al-Faries, Al-Khalifa, Al-Razgan & Al-Duwais, 2013). Although Libya has very limited resources in terms of ability, capacity, economy and basic facilities to implement e-government projects, the country has made considerable progress in bringing government services provided in different parts of the country to their citizens (Eldresi & Sweisi, 2012). Also, having a relatively small population but one that has a high educational profile may help to establish the e-government system faster (Saadi & Almahjoub, 2012). Therefore, in order to be inclusive and ensure equal access to all citizens in the country, the Libyan government should ensure the usability and accessibility of information and services provided via online platforms

to Libyan citizens for them to obtain the maximum benefit from government services.

2.3 Usability

In recent years, the number of government websites on the Internet has increased considerable; however, most do not fulfill users' needs and expectations (Granizo, Yanez, Ramirez & Machado, 2011). Although governments provide better information, services and support for people in the country through their websites, if they lack the necessary usability features, citizens face problems, which prevent them from getting the full benefits (Asiimwe & Lim, 2010; Huang & Brooks, 2011). Therefore, delivering usable online information and services via websites has been gaining more importance for years within the e-government context. Besides, usability is a very critical issue in terms of its potential to improve the quality of services delivered by governments (Nielsen, 1994). Furthermore, "usability improves users' trust in e-government" (Youngblood & Mackiewicz, 2012, p. 583).

Most researchers (e.g., Matera, Rizzo, & Carughi, 2006; Islam, Rahman & Islam, 2017) defined usability highlighting specific quality characters of the designed and developed systems that affect the delivery of better services to users. Nielsen (2012) defined usability based on the five quality components of learnability, efficiency, memorability, errors, and satisfaction. According to ISO 9241-210, usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use".

Some researchers have also attempted to develop methods for the usability evaluation of websites. For example, originally developed in 1990 by Nielsen and Molich (1990), and revised in 1995 by Nielsen, the heuristic evaluation list contains 10 items addressing 249 usability problems based on a factor analysis (Nielsen, 1995). This evaluation has become one of the most commonly used and popular assessment method of usability (Nabovati, Vakili-Arki, Eslami & Khajouei, 2014; Al-Khalifa, Al-Twaim, & AlHarbi, 2016).

In Nielsen's heuristic evaluation, the 10 heuristic items refer to essential features and properties of user-friendly systems (Nabovati, Vakili-Arki, Eslami & Khajouei, 2014). The purpose of using heuristics is to assess the issues caused by usability problems (Kientz, Choe, Birch, Maharaj, Fonville, Glasson & Mundt, 2010). In the heuristic evaluation, the evaluator analyzes the interface of the system and identifies usability problems according to the heuristic items (Zhang, Johnson, Patel, Paige & Kubose, 2003). Usability heuristics is a very important tool not only for evaluators who test the systems, but also for developers who design and develop the systems through the development life cycle (Pribeanu, 2014).

Nielsen (1995) explained the 10 heuristic items as follows:

- Visibility of the system status: "The system should always keep users informed about what is going on, through appropriate feedback within reasonable time".
- Match between the system and the real world: "The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order".
- User control and freedom: "Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo".
- Consistency and standards: "Users should not have to wonder whether different words, situations, or actions mean the same thing".
- Error prevention: "Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action".
- Recognition rather than recall: "Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate".

- Flexibility and efficiency of use: "Accelerators — unseen by the novice user — may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions".
- Aesthetic and minimalist design: "Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility".
- Help users recognize, diagnose, and recover from errors: "Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution".
- Help and documentation: "Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large".

Heuristic evaluation is considered to be one of the best usability assessment methods since it does not require a long time and special equipment to evaluate the websites and identify usability issues (Al-Khalifa, 2010). In heuristic evaluation, users do not need to attend the evaluation process, which is one of the benefits of heuristics compared to other usability evaluation methods (Liu & Hayes, 2010). Besides, heuristic evaluation has been very popular among developers for its cost and time effectiveness and potential to provide valuable feedback to fix usability problems and enhance the quality of websites (Donker-Kuijer, de Jong & Lentz, 2010).

The aim of heuristic evaluation is to identify usability problems in government websites that people may encounter when receiving a service or obtaining information from those websites (Pribeanu, 2014). However, there are very limited number of studies that evaluated the usability of government-based digital public services utilizing heuristics, and the majority of these studies use Nielsen’s heuristic items as a usability inspection method (Al-Khalifa, 2010). Therefore, in order to understand usability problems of government websites, heuristics should be applied more extensively in the e-government context.

2.4 Heuristic Usability Evaluation of Government Websites

In the literature, there are a few studies regarding the usability evaluation of government websites using heuristic items as a usability inspection method. Alotaibi (2013) conducted a study on the heuristic usability evaluation of 12 private and state university websites in Saudi Arabia with 30 evaluators using a list of developed heuristics. The results showed a positive attempt towards designing and developing user-friendly university websites in Saudi Arabia. Besides, public university websites were found to be more usable compared to private university websites.

Al-Khalifa (2010) explored the usability of 14 Saudi government websites using heuristics with two experts. The results demonstrated many usability problems on the evaluated government websites; however, all the evaluation criteria such as design and consistency, navigation, help, and feedback were scored more than 50%. Therefore, the author reported this indicated a tendency towards designing government websites with usable characteristics. In another study, two Saudi e-government websites were evaluated using heuristics with three experts being employed as evaluators. Based on the results, the authors concluded that both the websites needed to be improved in terms of usability features to meet user needs and increase user satisfaction (Eidaroos, Probets & Dearnley, 2009).

Islam, Rahman and Islam (2017) employed heuristics to examine the usability of 6 e-government websites in Bangladesh. Thirty-two post-graduate students conducted the evaluation as experts in the usability field. The results revealed that the evaluated websites had critical usability problems and the designers and developers needed to improve government websites in order to fulfill the citizens' requirements. Hasan (2013) analyzed the usability issues of three large public universities websites in Jordan using heuristic evaluation. Five evaluators that were usability specialists and web experts identified a total of 34 usability problems. Based on the several significant problems found in the study, the author highlighted the importance and efficiency of the heuristic evaluation method in revealing the usability problems. Ansari, Baqar, Hassan and Saeed (2016) examined the accessibility and usability of 30 government websites in Pakistan according to WCAG 2.0 and Nielsen’s heuristics. The results showed that these websites needed improvement according to

accessibility and usability standards and principles to make them more accessible and usable for the citizens in the country.

2.5 Web Accessibility

Web technologies, as a part of information technologies, should be made available for all people including the disabled and the elderly so that they can effectively use these technologies in their daily lives. All people including physical or cognitive impairments must be provided with an equal chance to access web technologies (Baowaly & Bhuiyan, 2012). It is essential to design and develop electronic services that are easily accessible by the target user groups (Shahkooh & KhodaBandeh, 2006). Web accessibility aims to make information and services easily accessible and available on the web by all potential users, specifically focusing on those with physical or mental disabilities (Abanumy, Al-Badi & Mayhew, 2005).

WCAG 2.0 provides recommendations and solutions for making web content more accessible to users. These recommendations are categorized into three levels of conformance checkpoints; level A, level AA, and level AAA. Details about each conformance level are given below (WCAG 2.0, 2008):

"Level A: For Level A conformance (the minimum level of conformance), the Web page satisfies all the Level A Success Criteria, or a conforming alternate version is provided".

"Level AA: For Level AA conformance, the Web page satisfies all the Level A and Level AA Success Criteria, or a Level AA conforming alternate version is provided".

"Level AAA: For Level AAA conformance, the Web page satisfies all the Level A, Level AA and Level AAA Success Criteria, or a Level AAA conforming alternate version is provided".

Guidelines regarding web accessibility are essential in that if they are not satisfactorily met, it would be very difficult for a considerable number of people to use e-government services (Al-Khalifa, 2012). The accessibility characteristics of e-

government implementations delivered via Internet technologies are highly dependent on the achievement of government attempts (Shahkooh & KhodaBandeh, 2006). All web technologies should be designed and developed with accessible characteristics that would give all people an equal chance to use these technologies (Sun & Chen, 2010). However, people with physical and cognitive disabilities and the elderly encounter more barriers that prevent them avoid from fully benefitting from web technologies provided by governments (Isa, Suhami & Safie, 2010; Sun & Chen, 2010). Therefore, it is necessary to conform to web accessibility guidelines to provide information and services to all citizens in an efficient way.

2.6 Accessibility Evaluation of Government Websites

In the literature, there are a number of studies focusing on the accessibility evaluation of government websites by implementing automation tools. For example, Latif and Masrek (2010) used the Bobby tool to evaluate the accessibility of government websites in Malaysia. The authors reported critical accessibility problems in all selected websites with none being able to pass the WCAG checkpoints. The most serious problem found in this study was providing alternative texts for each non-text element in the website. In another study in Malaysia, the EvalAccess 2.0 tool was used to test the accessibility of 155 government websites. The results showed that the selected websites had many accessibility problems and they needed to be improved according to the accessibility criteria to be more accessible for the people with disabilities in the country (Isa, Suhami & Safie, 2010).

Akgul and Vatansever (2016a) evaluated 25 Turkish government websites using different automation tools namely AChecker, examinator, TAW, Total Validator, WAVE, Web Accessibility Assessment tool, EvalAccess, Cynthia Says, MAGNTA, HERA, Amp, and Sort site. According to the results, the government websites were found to have critical accessibility violations and problems, and almost all the evaluated websites failed to meet the minimum level of accessibility requirements for the disabled people. In another study, the web content accessibility of 30 Turkish municipal websites was tested with the TAW tool. The authors found that the evaluated websites violated most accessibility checkpoints and had very low-level web accessibility characteristics (Akgul & Vatansever, 2016b).

Al-Radaideh, Nuser and Wahbeh (2011) examined the accessibility of 25 Jordanian government websites using two different methods; the TAW tool and manual checking. The results indicated that all these websites had serious accessibility problems, violated conformance checkpoints, and did not meet the WCAG 2.0 requirements of accessibility. AbuAli, Obedidat and Abu-Addose (2013) evaluated the web accessibility issues of a government website in Jordan with the Bobby tool and suggested that the quality of the website need improvement particularly paying attention to the problems regarding the lack of alternative texts for all non-text elements, a title for each frame, and alternative explanations for each object.

Tashtoush, Darabseh and Al-Sarhan (2016) conducted an accessibility evaluation study to test the Arabic and English versions of 10 government websites selected randomly from 10 countries. AChecker, TAW, WAVE and Sort Site tools were used in the evaluation. According to the results, the website from Egypt was found to be the best in Arabic and English versions. However, the Arabic version of the Sudan website and the English version of Dubaian website were found to be the worst in terms of accessibility. Abanumy, Al-Badi and Mayhew (2005) tested the accessibility of government websites from Saudi Arabia and Oman using different evaluation tools namely Watchfire, Bobby W3C HTML Validator, and UsableNet LIFT. The authors suggested that these countries needed to increase their awareness about the importance of accessibility, and place more emphasis on the accessibility of government websites to provide an equal chance to all their citizens concerning access to government services.

Baowaly and Bhuiyan (2012) evaluated the accessibility of 10 government websites in Bangladesh by applying some of the well-known automation tools; W3C Markup Validation Service, AChecker, and EvalAccess. The authors also collected data from users with visual impairments. The results of the study revealed that the websites failed to meet the accessibility criteria; thus, the authors suggested that government should introduce regulations and policies that would promote the design and development of accessible government websites, and web developers should be made aware of the importance of accessibility and encouraged to utilize available tools to

design more accessible websites. In another study, Adepoju, Shehu and Bake (2016) evaluated 36 government websites in Nigeria using the TAW tool and Site Analyzer. The authors reported that all the tested government websites failed to pass the conformance checkpoints at all levels due to the accessibility errors; thus, their accessibility characteristics should be improved.

Al-Faries, Al-Khalifa, Al-Razgan and Al-Duwais (2013) examined the accessibility and usability of the top government web services in Saudi Arabia based on the WCAG 2.0 guidelines and expert evaluation, respectively. All the tested websites were found to violate the accessibility checkpoints with the main problems being related to the use of text alternatives, keyboard accessibility, and compatibility. The authors recommended that web developers should follow and adopt international accessibility and usability guidelines to make government websites easier to use, manage and understand for all the citizens in the country. Al-Khalifa (2012) tested the accessibility of Saudi Arabia government websites according to WCAG and found several accessibility errors in all websites with none meeting the criteria for the minimum level of accessibility checkpoints. The most critical problem was reported to be providing alternative text explanations for all non-text elements.

Sun and Chen (2010) explored the accessibility of 347 Chinese local government websites using the Truwex Online 2.0 tool. According to the results, none of these websites passed W3C Priority 1 accessibility checkpoints. Kuzma, Yen and Oestreicher (2009) evaluated the levels of accessibility of e-government websites in the European Union, Asia and Africa by implementing an online automation tool called TAW. The results indicated that most of the websites in not only underdeveloped but also developed countries did not fulfill the requirements of accessibility provided by guidelines. Therefore, the authors concluded that the governments from both groups of countries needed to properly improve the design of their websites in order to ensure equal access and ease of use options for all citizens.

Another study conducted by Ismailova and Inal (2016) aimed to determine the accessibility and quality of ministry websites in Kyrgyzstan, Azerbaijan, Kazakhstan, and Turkey. Sixteen websites for each country were tested using the Pingdom and

AChecker online automation tools. The authors reported that only three government websites in Kyrgyzstan and five government websites in Kazakhstan met the minimum level of requirements (conformance level A). Based on the results, the authors concluded that it was very obvious that the governments in these countries should spend more effort to make ministry websites more accessible in order to provide better services for all their citizens including the disabled and elderly people.

CHAPTER 3: METHODOLOGY

3.1 Case Study 1 - Usability Evaluation of a Libyan Government Website

The first aim of this case study was to evaluate the usability of the Management of Scholarships website using heuristics. Heuristic evaluation is one of the most commonly used techniques to identify usability problems (Paz, Villanueva, Rusu, Roncagliolo & Pow-Sang, 2013). The method has also been utilized in many studies to evaluate the usability of government websites (e.g., Eidaroos, Probets & Dearnley, 2009; Al-Khalifa 2010; Sivaji, Abdullah & Downe, 2011; Granizo, Yanez, Ramirez & Machado, 2011). Heuristic evaluation does not require special equipment or a high number of evaluators and it allows analyzing the website in a short time to determine the usability problems related to heuristic items (Al-Khalifa, 2010). The method is also suitable for optimizing government websites (Sivaji, Abdullah & Downe, 2011). Nielsen's heuristics (1995) are one of the most popular and widely used inspection methods for usability evaluation.

In this study, Nielsen's heuristics (1995) were applied to evaluate the Management of Scholarships website. Previous articles have recommended supporting the results of heuristics results with multiple data collection methods (e.g., Zhang, Johnson, Patel, Paige & Kubose, 2003) to identify more usability problems. More specifically, Nielsen and Molich (1990) reported that the think-aloud process might be used to enrich the heuristics results for usability evaluation. Therefore, in this study, in addition to heuristic evaluation, data was enriched by note-taking and the think-aloud method.

3.1.1 Website Selection Process

The website selection was based on the results of a demographic survey administered to 190 Libyan graduate students. The students were asked to select the website they most visited from the list of 10 Libyan government websites used in Case Study 2. Of the participants, 55% were male and 45% were female. The mean age of the participants was 32.6 (SD = 8.16). All the participants graduated from a university in Libya. As the most visited website, 41.6% (n = 79) selected the Management of Scholarships website, 21.6% (n = 41) the National Number Project website, and 20.5% (n = 39) the Ministry of Higher Education & Scientific Research website. Therefore, in this study, the Management of Scholarships website was selected to evaluate usability in depth through user research.

3.1.2 Participants

For the heuristic evaluation, 32 of the 79 participants that selected the Management of Scholarships website (6 male and 26 female) volunteered to take part in the usability evaluation process. All the participants were either Master or PhD students studying abroad.

3.1.3 Usability Heuristics

The usability evaluation was performed using 10 heuristics developed by Nielsen (1995) and shown in Table 1.

Heuristics	Severity					Comments / Explanations
	No Problem	Cosmetic	Minor	Major	Catastrophic	
Visibility of system status						
Match between system and the real world						
User control and freedom						
Consistency and standards						
Error prevention						

Recognition rather than recall						
Flexibility and efficiency of use						
Aesthetic and minimalist design						
Help users recognize, diagnose, and recover from errors						
Help and documentation						

Table 1. Nielsen's usability heuristics and rating of severity

A severity scale has been used in many studies to identify and categorize the criticality of each usability problem (e.g., Sivaji, Abdullah & Downe, 2011; Granizo, Yanez, Ramirez & Machado, 2011; Nabovati, Vakili-Arki, Eslami & Khajouei, 2014). Similarly, in this study, in order to better understand the usability problems identified for each heuristic item, a severity scale was utilized.

3.1.4 Management of Scholarships Website

The Management of Scholarships website was created in 2016 and came online in December of that year. The website is a platform for students who have been sent to study abroad by the Ministry of Higher Education & Scientific Research. The website provides services such as news and announcements about their study program, and information about their grant payments. The students can track communications sent to them by the Embassy through the mail tracking system.

3.1.5 Tasks

Each task aimed to evaluate a specific interface and the participants were asked to complete the tasks without any time limitation. The aims of the tasks were to make participants visit all the pages of the website and perform all functions provided by the website. The first task was about the mail tracking system, which allowed tracking documents sent by the Embassy. In this task, the participants first examine

whether the mails arrived at the Management of Scholarships in Libya. If it did, then the participant inquired whether the Management of Scholarships responded to these mails and sent them back to the Embassy. As a second step, the participants checked their grant payments to see if there were any problems with the amounts.

The second task concerned the procedures involving the rules and regulations that students have to follow to apply for an extension of the study period or update their marital status. The third task was to access the announcements from and correspondence with Management of Scholarships. The participants were expected to display the latest news published by Management of Scholarships, to make comments, and give feedbacks about the website.

3.1.6 Data Collection Procedure

Before the experiment, the participants were given brief information about the purpose of this study, details about the evaluation process, and instructions to follow during the evaluation. The participants were informed about usability heuristics and asked to think aloud during the evaluation. The participants performed each task sequentially. When they found any violation of the heuristics, they reported the severity of the problem, related heuristic item, detailed information about the problem, and the problematic interface. The researcher observed each participant when performing the given tasks and took notes during the evaluation. Each evaluation process took approximately 25 minutes. At the end of the evaluation, the participants completed a demographic survey.

3.2 Case Study 2 - Accessibility Evaluation of the Libyan Government Websites

The second aim of this case study was to evaluate the accessibility of Libyan government websites. In the evaluation process, the selected websites were tested automatically using well-known accessibility evaluation tools in order to determine their accessibility performance in relation to the WCAG conformance level checkpoints. The tests were performed using the WCAG 2.0 accessibility guidelines.

The accessibility evaluation of websites can be easily performed by implementing automation tools based on accessibility guidelines (AbuAli, Obedidat & Abu-Addose, 2013). Automation tools produce evaluation reports regarding the

accessibility evaluation of websites for not only maintainers but also web designers (Abanumy, Al-Badi & Mayhew, 2005). Evaluating government websites and making necessary changes according to the feedbacks from the automation tools are also very helpful to improve the overall quality of websites (Ismailova & Inal, 2016).

The results of online evaluation tools can be beneficial in the design, development and maintenance of government websites, and as a result, accessibility barriers are less encountered by citizens when using these websites (Ismailova & Inal, 2016). In the literature, several studies have performed an accessibility evaluation of government websites by implementing automation tools (e.g., Latif & Masrek, 2010; Kurt, 2011; Luján-Mora, Navarrete & Peñafiel, 2014; Al-Khalifa, Baazeem & Alamer, 2016).

3.2.1 The Websites Evaluated

In this study, 10 Libyan government websites were evaluated via automation tools according to the conformance level A, AA and AAA checkpoints provided by WCAG 2.0 accessibility guidelines. The following Libyan government websites were selected for the evaluation:

- Management of Scholarships (http://lsa.ly/home)
- National Number Project (http://www.nid.gov.ly)
- Ministry of Higher Education & Scientific Research (http://www.highereducation.gov.ly)
- Ministry of Culture & Civil Society (http://www.culture.gov.ly)
- Ministry of Finance and Planning (http://www.mofp-ly.com)
- Ministry of Interior (http://moi.gov.ly)
- Ministry of Foreign Affairs (http://www.foreign.gov.ly)
- General Authority for Communications and Informatics (http://www.cim.gov.ly)
- Ministry of Defense (http://www.defense.gov.ly)
- Ministry of Agriculture, Livestock and Marine (http://agriculture.gov.ly)

3.2.2 Materials

Implementing automation tools is one of the best ways of evaluating and determining the accessibility and web performance of websites (Ismailova & Inal, 2016). There are many evaluation tools that help designers and developers to identify accessibility problems in a website. However, the number of violations derived from each automation tool significantly differs (Tashtoush, Darabseh & Al-Sarhan, 2016). Therefore, in this study, in order to minimize the differences caused by different tools, two most commonly used evaluation tools, AChecker and TAW, were used to perform accessibility evaluation tests.

AChecker is the most commonly used online free web accessibility evaluation tool available at http://achecker.ca. It was developed by the Adaptive Technology Resource Centre in the University of Toronto (Gay & Li, 2010). The tool helps evaluators to assess websites according to the WCAG 2.0 accessibility guidelines. AChecker is also one of the most popular evaluation tools that have been implemented by several studies to evaluate website accessibility (e.g., Olalere & Lazar, 2011; Baowaly & Bhuiyan, 2012; Vigo, Brown & Conway, 2013; Youngblood, 2014; Ismailova & Inal, 2016; Ismailova & Inal, 2017).

TAW is another popular online free web accessibility evaluation tool available at http://www.tawdis.net/. It was developed by the Spanish Foundation CTIC and supports multi-platforms for the evaluation of WCAG 2.0 conformance level A, AA and AAA (Tashtoush, Darabseh & Al-Sarhan, 2016). Studies using the TAW tool to evaluate the accessibility of websites in the literature include Al-Radaideh, Nuser and Wahbeh (2011), Gonçalves, Martins, Pereira, Oliveira and Ferreira (2012), Akgul and Vatansever (2016a), and Adepoju, Shehu and Bake (2016).

CHAPTER 4: RESULTS

4.1 Usability Evaluation

Nielsen's heuristics evaluation was conducted by 32 evaluators on the Management of Scholarships website. At the end of the evaluation process, 168 usability problems were identified. After removing the duplicates, 65 unique usability problems were obtained. The analysis in this section focuses on the unique usability problems (Table 2).

Table 2 shows that the evaluators reported a higher number of unique usability problems regarding certain heuristic items. The most frequently violated heuristic items were "help users recognize, diagnose, and recover from errors" and "user control and freedom" found 11 times (17%), followed by "visibility of system status" identified 10 times (15%). However, usability problems concerning other heuristic items were less than 10 problems per item. The least violated heuristic items were found to be concerning "aesthetic and minimalist design" (2 errors, 3%) and "help and documentation" (3 errors, 5%). In addition, none of the evaluators reported any usability problems concerning the heuristic item, "match between system and the real world".

	Severity					
Heuristics	**Cosmetic**	**Minor**	**Major**	**Catastrophic**	**Total**	**Example(s)**
Visibility of system status	0	3	3	4	10	lack of visibility of the system status in the search process, lack of adequate

						feedback in the mail tracking system, and poor response in performing tasks
Match between system and the real world	0	0	0	0	0	-
User control and freedom	0	4	4	3	11	lack of user control on the Call Us screen and usability problems regarding the login dialogue box of the mail tracking system and the search tab
Consistency and standards	2	4	2	0	8	lack of enough colors and fonts to make the interface design clearer for users, lack of consistency in the use of functions, tabs, and buttons
Error prevention	0	4	2	1	7	inconsistency in the appearance of error messages on webpages, and lack of essential and necessary information in

						error message explanations
Recognition rather than recall	1	2	2	1	6	lack of hints on elements to explain their purpose
Flexibility and efficiency of use	0	2	4	1	7	difficulties in navigating between the pages and lack of visuals in the design resulting in users spending too much time and effort and reducing their efficiency
Aesthetic and minimalist design	2	0	0	0	2	lack of attractive colors and clear icons, images, figures and pictures to make related functions clear and understandable for users
Help users recognize, diagnose, and recover from errors	0	3	4	4	11	ambiguous error messages, little details about errors, lack of detailed explanations in error messages, lack of clear messages

						about errors, and poor and inconsistent appearance of error messages
Help and documentation	0	1	1	1	3	lack of help features where necessary
Total # of unique problems	5	23	22	15	65	-

Table 2. The number of unique usability problems identified by the evaluators

In their rating of the identified usability problems based on their severity, the evaluators tended to use the categories 'mostly minor' or 'major' more than cosmetic and catastrophic. According to the results, while only 5 and 15 errors were categorized as cosmetic and catastrophic, respectively, 23 and 22 errors were considered to be minor and major, respectively (Figure 1). More than half of the usability problems were rated as major or catastrophic by the evaluators.

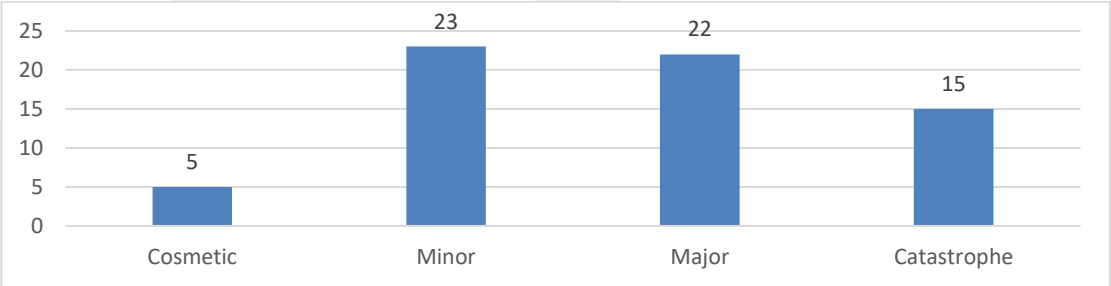

Figure 1. The frequency of heuristic violations by severity rating

The severity of more than 50% of the usability problems concerning four heuristics (Items 1, 3, 7, and 9) was major or catastrophic. More specifically, in two heuristics, "visibility of system status" and "help users recognize, diagnose, and recover from errors", the most frequently violations were rated as catastrophic. The evaluators reported cosmetic usability problems only concerning 3 out of 10 heuristics, which was significantly fewer compared to the number of problems rated as major, minor, or catastrophic.

Examples of each heuristic item highlighted by the evaluators are given in Table 2. Regarding the item, “visibility of system status”, the evaluators mainly reported the lack of visibility of the system status in the search process, lack of adequate feedback in the mail tracking system, and poor response in performing tasks. The lack of control issue on the Call Us screen and usability problems concerning the login dialogue box of the mail tracking system and the search tab were reported in relation to the item, “user control and freedom”. When analyzing the problems related to the “consistency and standards” item, the evaluators focused on the design of the website. They reported lack of enough colors and fonts to make the interface design clearer for users and the lack of consistency in the use of functions, tabs, and buttons.

Inconsistency regarding the appearance of error messages on webpages and the lack of essential and necessary information in error message explanations were reported to be usability problems under the “error prevention” item. Concerning the “recognition rather that recall” item, the evaluators highlighted the “lack of hints on elements to explain their purpose”. Navigation difficulties were mostly found related to errors regarding “flexibility and efficiency of use”. The evaluators reported difficulties in navigating between the pages and the lack of visuals in the design that resulted in users spending too much time and effort and reduced their efficiency.

The evaluators criticized the visual design of the website in terms of color use, typography, and etc. under different heuristic items. Concerning “aesthetic and minimalist design”, they reported lack of attractive colors and clear icons, images, figures and pictures to make related functions clear and understandable for users. The design, placement and content of error messages in the website were one of the most highlighted usability errors reported by the evaluators. In relation to the item, “help users recognize, diagnose, and recover from errors”, the evaluators reported ambiguous error messages, little details about errors, lack of detailed or clear explanations about error messages, and poor and inconsistent appearance of error messages. During the evaluation, the majority of the participants did not need any help when completing the given tasks. Therefore, the lack of help features where

necessary was reported as a usability problem by a very few evaluators under the “help and documentation” item.

The evaluators generally focused on similar usability violations but they rated their severity differently. The details of usability problems for each heuristic item are given in the following sub-sections.

4.1.1 Visibility of System Status

The evaluators reported 10 usability problems regarding the item, “visibility of system status”. Of the 10 usability problems, 3 were categorized as minor, 3 as major and the remaining as catastrophic. Twelve evaluators reported no usability problems regarding the visibility of system status.

The lack of adequate feedback in the mail tracking system and poor response in performing tasks were rated as minor, major, or catastrophic problems by the evaluators. Similarly, the lack of visibility of system status of the search component that makes it difficult for users to understand the search process was rated as minor, major or catastrophic. One of the evaluators rating this usability problem as minor explained that "the mail tracking system takes too long to respond to our mails" and another evaluator stated that "there is a problem in the search process, so I did not get any response". During the observation, it was seen that when the evaluators tried to search something on the website, the search component did not work. As catastrophic usability problems, the evaluators highlighted the general lack of adequate feedback where necessary when interacting with the website and criticized the inadequacy of responses for important requests.

4.1.2 Match between System and the Real World

All the evaluators in the study reported that they did not face any problems regarding the item, “match between system and the real-world”. One of the evaluators stated that “there is no problem related to the language because the website uses our native language”. This may be because the evaluators focused on the language of the website to identify usability problems rather than other possible problems related to

this item such as using technical terminology that is not easily understandable by users.

4.1.3 User Control and Freedom

Concerning the “user control and freedom” item, the evaluators reported 11 usability problems and categorized these problems as minor (n = 4), major (n = 4) or catastrophic (n = 3). Only 3 evaluators reported that there was no usability problem regarding user control and freedom.

The usability problems concerning the login dialogue box of the mail tracking system and the search tab were rated as minor, major or catastrophic by the evaluators. The evaluators stated that they felt very uncomfortable when they encountered this problem. Besides, the lack of control on the Call Us screen was rated as a minor, major or catastrophic usability problem. One of the evaluators that regarded this to be a major problem explained that the website did not produce any messages to ask for confirmation to cancel actions and gave the following example: " I tried to send a message through the website but then decided to cancel this message and go back; however, there was no message that prompted me to confirm or cancel this action". The search process was evaluated as being very problematic by almost all the evaluators under different heuristic items. For example, the lack of an exit option on the search page was rated as a catastrophic usability problem under the user control and freedom heuristic item. One of these evaluators explained that “the website did not give any options for quick exit. For example, when I used the search tab, it did not work. There was an error but I could not find any option to close the error box”.

4.1.4 Consistency and Standards

The evaluators reported 8 usability problems regarding the “consistency and standards” item, categorizing 2 as cosmetic, 4 as minor, and the remaining as major. Most evaluators (n = 24) reported that there was no usability problem about consistency and standards. The evaluators highlighted a higher number of unique usability problems in this heuristic item compared to the other items. They reported

minor problems to be the lack of enough colors and fonts to make the interface design clearer for users, lack of consistency in the use of functions, tabs, and buttons on the pages. One of these evaluators explained the problem with tabs as follows: “Tabs are expected to be used actively and continuously, but they are not clear or simple”. Others evaluators reported inconsistent tab use as a major usability problem. In addition, inconsistency in feedback given by the website was another major usability problem reported by the evaluators. As cosmetic problems, the evaluators reported that the website did not have a good design and improvements could be made to the color and fonts used to make them more consistent and understandable. One of the evaluators explained these cosmetic problems as follows: “The website need to be more organized. There is also no harmony between the colors, fonts and font size".

4.1.5 Error Prevention

Concerning the “error prevention” item, the evaluators reported 7 usability problems, which they categorized as minor (n = 4), major (n = 2), and catastrophic (n = 1). More than half of the evaluators (n = 17) reported that there was no usability problem regarding error prevention.

All the evaluators referred to different aspects of the usability problems in error messages when explaining their choice of rating. They mainly stated that error messages did not appear on all web pages when they expected them to be displayed. While some pages contained error messages in detail to inform users, other pages either did not have any error messages or included very ambiguous and unclear error explanations. One evaluator explained the problems in error messages as, “error messages were written in an understandable language but they did not appear every time I needed them and when they were displayed, they sometimes did not give detailed explaining about the error”. The evaluators also focused on inconsistency in error message appearance on webpages and the lack of essential and necessary information in error message explanations.

4.1.6 Recognition Rather than Recall

The evaluators reported 6 usability problems regarding the item, “recognition rather than recall”, rating 1 as cosmetic, 2 as minor, 2 as major, and 1 as catastrophic. Only 9 evaluators reported that there was no usability problem about recognition rather than recall.

The lack of hints on the elements to explain their purpose on the website was rated as a minor or cosmetic usability problem by the evaluators. An evaluator that considered this to be a minor problem stated that “when I moved the mouse cursor onto a button or other elements, the website did not give any hints about them”. Regarding the problems related to the lack of hint elements, the evaluators gave specific examples from the Call Us page. The main usability problem on the Call Us page related to the visitors having to remember all data entering fields when sending a letter was rated as a minor, major or catastrophic by the evaluators. The evaluators stated that the website should give hints or clues about how to fill in these fields. Similarly, the lack of hints in the menu items of the website was reported as a usability problem rated as having major or catastrophic severity. The evaluators that regarded this to be a major problem explained this choice by stating, “all the items, icons and buttons were stable, and they did not provide any help; so, it took time and effort to remember their aim and function”.

4.1.7 Flexibility and Efficiency in Use

Concerning the item, “flexibility and efficiency in use”, the evaluators reported 7 usability problems and categorized them as minor (n = 2), major (n = 4), and catastrophic (n= 1). More than half of the evaluators (n = 17) reported that there was no usability problem regarding flexibility and efficiency in use.

In terms of minor problems, the evaluators reported that users expended much time and effort to find the link to enter the mail tracking system since it was in an obscure location on the website. Furthermore, difficulties in navigating between the pages were highlighted as a minor or major usability problem. One evaluator that considered this as a minor problem explained that “the navigation system on the website should be more effective; it was very difficult to access the mail tracking system”. The evaluators reported that the lack of visuals in the design resulted in

spending too much time and effort and reduced their efficiency when performing the tasks, and they considered this to be a major or catastrophic usability problem. They stated that the design of the website should be more efficient and effective. One of the evaluators further explained that “there should be some visuals such as arrows, images, hints, or clues to help people to use this website easily and effectively”.

4.1.8 Aesthetic and Minimalist Design

The evaluators reported only 2 usability problems regarding the “aesthetic and minimalist design item”, both of which were categorized as cosmetic. Most evaluators (n = 21) reported that there was no usability problem about aesthetic and minimalist design.

The evaluators criticized the website design for not including more attractive colors. The lack of attractive colors and clear icons, images, figures and pictures to make related functions clear and understandable for users were rated as cosmetic usability problems. In addition, the evaluators that criticized the general design of the website reported that some pages such as the page on grant payments were very messy and complex, and the content and design should have been organized better. An evaluator further explained this by stating that “I did not feel comfortable with the colors; it would be better if the website had clear and attractive colors to make users enjoy their visit".

4.1.9 Help Users Recognize, Diagnose, and Recover from Errors

Concerning the item, “help users recognize, diagnose, and recover from errors”, the evaluators reported 11 usability problems, categorizing them as minor (n = 3), major (n= 4), and catastrophic (n = 4). Less than half of the evaluators (n = 12) reported that there was no usability problem regarding this item.

In terms of minor problems, the evaluators reported ambiguous error messages, little details about errors, lack of detailed explanations in error messages, lack of clear messages about errors, and poor and inconsistent appearance of error messages on the website. One of the evaluators explained this issue as follows: “I received an

error message on the login page but the website did not give any specific details about the error; so, I did not understand the reason for this error, which may have been about the username or password". Similarly, the lack of clear error message explanations and the use of ambiguous explanations were rated as major or catastrophic usability problems. In addition, the evaluators reported the lack of understandable instructions to solve problems they encountered as a major usability problem. Furthermore, since the mail tracking system was one of the main and prominent government services that attracted a lot of visitors to the website, some evaluators specifically addressed problems on the page of this system such as the lack of error messages, which they rated as catastrophic. One of the evaluators explained, "the website provided very ambiguous messages or explanations without offering any solutions to help users avoid these errors in future". In addition, the location of error messages included in the mail tracking system was categorized as a catastrophic problem.

4.1.10 Help and Documentation

The evaluators reported only 3 usability problems regarding the "help and documentation" item, rated as minor, major, or catastrophic. Only 5 evaluators reported that there was no usability problem about this item.

The evaluators highlighted the lack of help features on the website as a minor, major or catastrophic usability problem. They referred to the lack of adequate help support for users or manuals that would provide instruction on how to use the website easily and effectively. One of the evaluators explained that "in order to understand some features or tasks of the website, I needed help but there was no help page or document". Similarly, as a major problem, the evaluators reported that there was a visual marker representing the help feature of the mail tracking system, but when they clicked the link, it did not work. Another notable result was that the participants that needed help when performing the given tasks tended to categorize the problems with help features as catastrophic compared to those that did not need any help during the evaluation. One of the evaluators that rated the usability problems concerning this item as catastrophic further explained that "I needed to get help to

understand what to do, but the website did not have the help feature. There is a help page in the mail tracking system, but it was under construction".

4.2 Accessibility Evaluation of the Libyan Government Websites

4.2.1 General Accessibility Evaluation

The results of accessibility evaluation of each Libyan government website are given in Table 3. Each tool produced different results in terms of accessibility evaluation of the government websites. The TAW tool reported more accessibility errors compared to the AChecker tool. Besides, in some cases, there was a very large gap between the results obtained from the two tools; e.g., while one tool reported very limited number of accessibility errors for a Libyan government website, the other identified more than one hundred errors for the same website. Therefore, the number and content of accessibility errors derived from both tools are separately analyzed and discussed in this section.

Libyan Government Websites	AChecker	TAW	Average
Management of Scholarships	0	41	21
National Number Project	21	9	15
Ministry of Higher Education & Scientific Research	21	36	29
Ministry of Culture & Civil Society	8	23	16
Ministry of Finance and Planning	9	63	36
Ministry of Interior	15	104	60
Ministry of Foreign Affairs	152	61	107
General Authority for Communications and Informatics	37	51	44
Ministry of Defense	10	125	68
Ministry of Agriculture, Livestock and Marine	14	43	29

Table 3. The average number of errors by website

The results showed that the Management of Scholarships website had no accessibility errors and passed the accessibility evaluation in AChecker, but had 41 errors according to TAW (Table3). Furthermore, the websites of National Number Project and Ministry of Culture & Civil Society had the lowest average number of errors according to TAW. However, some government websites had a higher average number of accessibility errors compared to others. For example, the Ministry of

Foreign Affairs website had the highest average number of errors (107 errors); 152 in AChecker and 61 in TAW. However, according to the results from TAW, the website with the highest number of errors (125 errors) was that of the Ministry of Defense.

The results in Table 4 show that the websites of Management of Scholarships and Ministry of Higher Education & Scientific Research passed the minimum level of conformance (level A) in AChecker whereas according to the TAW tool, they had 34 and 27 errors, respectively. The highest number of conformance level A errors was found in the General Authority for Communications and Informatics website (n = 37) in AChecker and the Ministry of Defense website (n = 84) in TAW. The National Number Project website had the lowest number of conformance level A errors according to both AChecker and TAW (n = 5 and n = 8, respectively).

Libyan Government Websites	**Number of Errors by Conformance Level**					
	Achecker			**TAW**		
	A	**AA**	**AAA**	**A**	**AA**	**AAA**
Management of Scholarships	0	0	0	34	0	7
National Number Project	5	0	16	8	0	1
Ministry of Higher Education & Scientific Research	0	21	0	27	0	9
Ministry of Culture & Civil Society	8	0	0	22	0	1
Ministry of Finance and Planning	6	3	0	59	0	4
Ministry of Interior	6	8	1	57	0	47
Ministry of Foreign Affairs	33	0	119	60	0	1
General Authority for Communications and Informatics	37	0	0	48	0	3
Ministry of Defense	10	0	0	84	0	41
Ministry of Agriculture, Livestock and Marine	10	4	0	33	0	10

Table 4. The number of errors in the selected Libyan government websites by conformance level

If a website satisfies the requirements of conformance level A, then conformance level AA and conformance level AAA errors need to be considered in order. As shown in Table 4, the TAW tool did not report any conformance level AA errors for

the tested Libyan government websites; however, there were accessibility errors at this level according to AChecker. The Management of Scholarships website passed the checkpoints at all three conformance levels. Although the Ministry of Higher Education & Scientific Research website also passed the minimum level of conformance (level A), it had the highest number of errors at level AA. This demonstrates that this website contains critical errors and should be updated in order to meet the requirements and criteria of the conformance level AA.

An interesting result of the study was that the website of the Ministry of Foreign Affairs had the highest number of conformance level AAA errors in AChecker, but the lowest number of conformance level AAA errors according to the TAW tool. In the website of the Ministry of Interior, TAW revealed 47 errors at the conformance level AAA; thus, this was the website with the highest number of errors among all the evaluated websites.

According to the results, only one government website, Management of Scholarships, passed the accessibility evaluation in AChecker; however, when both tools were considered, none of the website passed the accessibility evaluation at all conformance levels. This demonstrates that all the selected Libyan government websites had accessibility errors that would make it very difficult for the disabled people to use these websites effectively, efficiently, and satisfactorily.

4.2.2 Checkpoints at the Conformance Levels

The results of accessibility evaluation of the 10 Libyan government websites were further analyzed to calculate the number of conformance level A, AA and AAA errors for each checkpoint. The results showed that the TAW tool reported more errors at different checkpoints than the AChecker tool. In the vast majority of the evaluated Libyan government websites, checkpoint 1.1.1 was violated at the conformance level A according to both AChecker and TAW. Checkpoint 1.1 is related to providing alternative texts for all non-text elements such as buttons, graphs, images or animations, and checkpoint 1.1.1 focuses particularly on non-text content. This demonstrates that the developers failed to provide alternative texts for all non-text objects in the selected government websites. According to the results

from both tools, this checkpoint was most violated by the Ministry of Foreign Affairs website (Table 5).

Libyan Government Websites	**Number of Level A Errors by Checkpoint**					
	1.1.1	**1.3.1**	**2.4.4**	**3.1.1**	**3.3.2**	**4.1.1**
Management of Scholarships	-	-	-	-	-	-
National Number Project	3	-	-	2	-	-
Ministry of Higher Education & Scientific Research	-	-	-	-	-	-
Ministry of Culture & Civil Society	5	1	1	-	1	-
Ministry of Finance and Planning	-	-	5	-	1	-
Ministry of Interior	3	2	-	-	1	-
Ministry of Foreign Affairs	26	3	1	2	1	-
General Authority for Communications and Informatics	2	-	32	2	-	1
Ministry of Defense	-	6	-	1	3	-
Ministry of Agriculture, Livestock and Marine	10	-	-	-	-	-

Table 5. The number of conformance level A errors by checkpoint derived from the AChecker tool

In TAW, checkpoints 1.3.1, 2.4.4, and 4.1.1 were found to be the most violated by the selected websites at the conformance level A (Table 6). TAW reported that all the websites violated checkpoint 1.3, which is directly related to cascading style sheets and creating website content that can be organized and presented in different ways without losing information or structure. Checkpoint 1.3.1, which concerns information and relationships, was most violated by the website of the Ministry of Defense according to both tools.

Checkpoint 2.4 ensures that the website is navigable and web content is easily findable to access and understandable where users are on the page, and checkpoint 2.4.4 focuses on the purpose of each link. Checkpoint 2.4.4 was violated by the majority of the Libyan government websites with the highest number of violations being obtained from the website of the General Authority for Communications and Informatics. Besides, checkpoint 4.1, which is about the adaptation of today's technologies such as assistive technologies to websites, was violated by almost all

the selected websites according to the TAW tool whereas only the General Authority for Communications and Informatics website violated this checkpoint in AChecker evaluation. Furthermore, Checkpoint 4.1.1 on parsing was most violated by the website of the Ministry of Finance and Planning in the TAW evaluation compared to the other websites.

Libyan Government Websites	**Number of Level A Errors by Checkpoint**							
	1.1.1	**1.3.1**	**2.4.4**	**3.1.1**	**3.2.2**	**3.3.2**	**4.1.1**	**4.1.2**
Management of Scholarships	6	8	8	1	-	-	11	
National Number Project	-	4	-	1	-	-	2	1
Ministry of Higher Education & Scientific Research	1	20	-	1	-	1	3	1
Ministry of Culture & Civil Society	12	1	7	1	1	-	-	-
Ministry of Finance and Planning	2	8	20	-	2	2	23	2
Ministry of Interior	17	18	11	1	-	1	5	4
Ministry Foreign Affairs	23	4	22	1	1	3	3	3
General Authority for Communications and Informatics	1	2	32	1	-	-	12	-
Ministry of Defense	17	21	13	1	1	4	22	5
Ministry of Agriculture, Livestock and Marine	1	8	10	1	-	-	13	-

Table 6. The number of conformance level A errors by checkpoint derived from the TAW tool

As shown in Tables 5 and 6, other checkpoints 3.1.1, 3.2.2, 3.3.2, and 4.1.2 were less violated by the Libyan government websites. In addition, only the TAW tool reported errors at checkpoints 3.2.2 and 4.1.2. All the websites except for that of the Ministry of Finance and Planning violated checkpoint 3.1.1 in the TAW evaluation. Checkpoint 3.1 states that all text content must be readable and easily understandable by all users, and checkpoint 3.1.1 particularly concerns the language of each page on the website. Only 4 out of 10 government websites violated checkpoint 3.2.2, which is about ensuring that the functions and appearance of all pages on a website are easily predictable for users.

Websites	Number of Level AA errors by Checkpoint	
	1.4.4	2.4.6
Management of Scholarships	-	-
National Number Project	-	-
Ministry of Higher Education & Scientific Research	18	3
Ministry of Culture & Civil Society	-	-
Ministry of Finance and Planning	2	1
Ministry of Interior	8	-
Ministry of Foreign Affairs	-	-
General Authority for Communications and Informatics	-	-
Ministry of Defense	-	-
Ministry of Agriculture, Livestock and Marine	3	1

Table 7. The number of conformance level AA errors by checkpoint derived from the AChecker tool

Only the AChecker tool reported errors at the conformance level AA. The Ministry of Higher Education & Scientific Research website violated checkpoint 1.4.4 most. Checkpoint 1.4 is related to creating a website that help users to see and hear the content by designing foreground and background clearly and understandably for users, and checkpoint 1.4.4 particularly focuses on resizing the text on the pages of a website. Only three Libyan government websites violated checkpoint 2.4.6, which concerns headings and labels, and as before, the highest number of violations belonged to the website of the Ministry of Higher Education & Scientific Research (Table 7).

Libyan Government Websites	Number of Level AAA Errors by Checkpoint		
	AChecker	TAW	
	1.4.6	2.4.9	2.4.10
Management of Scholarships	-	5	2
National Number Project	16	-	1
Ministry of Higher Education & Scientific Research	-	6	3
Ministry of Culture & Civil Society	-	-	1
Ministry of Finance and Planning	-	-	4
Ministry of Interior	1	38	9
Ministry of Foreign Affairs	119	-	1
General Authority for Communications and Informatics	-	2	1

Ministry of Defense	-	23	18
Ministry of Agriculture, Livestock and Marine	-	4	6

Table 8. The number of conformance level AAA errors by checkpoint derived from both tools

Table 8 shows that accessibility evaluation tools used in this study reported errors in different checkpoints at the conformance level AAA. For example, the AChecker tool reported that some of the Libyan government websites only violated checkpoint 1.4.6 at this conformance level whereas according to the results of the TAW tool, most Libyan government websites violated checkpoints 2.4.9 and 2.4.10 at the conformance level AAA. Only three government websites violated checkpoint 1.4.6 on the use of contrast on web pages, and the website of the Ministry of Foreign Affairs violated this checkpoint most. All the websites violated checkpoint 2.4.10, which is about using heading elements (H1, H2, H3, etc.), but the website of the Ministry of Defense website violated this checkpoint most.

CHAPTER 5: DISCUSSION

Usability and accessibility are among the most critical quality criteria for government websites to provide better services for all their citizens including the disabled and elderly people. They are also very crucial for governments to disseminate information and services across all the citizens since users do not prefer visiting a website again in the future if they face a complex interface and low usability characteristics (Matera, Rizzo & Carughi, 2006). Therefore, developers need to pay more attention to usability issues of government websites in order to design and develop effective, efficient and satisfactory products (Darem & Suresha, 2012) and to make government services accessible to a large number of citizens (Huang & Brooks, 2011).

In this study, for the usability evaluation, the Management of Scholarships website was analyzed based on Nielsen's heuristics evaluation. The main purpose of the website is to provide a platform for the mail tracking system for graduate students studying abroad. However, the results showed that the website generally had a large number of usability problems. One of the most significant usability problems identified by the participants concerned difficulties in accessing the mail tracking system in the website. Therefore, it can be concluded that the main functions of government websites should be located effectively for citizens to easily access.

Besides, these results are in line with those of previous heuristics evaluation studies on government websites conducted by Al-Khalifa (2010) and Islam, Rahman and Islam (2017), who evaluated Saudi and Bangladesh government websites, respectively. The authors of these studies concluded that Saudi and Bangladesh government websites had critical usability problems that made it difficult for the citizens to use them effectively.

Problems regarding search functionality on the Libyan government websites were frequently reported by the participants. The lack of visibility of the system status in the search process and usability problems regarding the search tab were highlighted under different heuristic items to be critical usability problems. Similarly, Al-Khalifa (2010) and Alotaibi (2013) concluded that search functionality and data entry forms were the most violated usability problems of evaluated government websites in Saudi Arabia.

The participants in the current study reported that the item related to the match between the system and the real world was not violated. This indicates that the website met certain user requirements regarding the use of a language in terms of phrases and words that are familiar to the target users. The most violated heuristic items were those concerning the visibility of system status, user control and freedom, and helping users to recognize, diagnose and recover from errors. These results are consistent with those reported by Nabovati, Vakili-Arki, Eslami and Khajouei (2014), who conducted a heuristic evaluation of government websites and found that the consistency and standards and the visibility of system status were most frequently violated.

Nabovati, Vakili-Arki, Eslami and Khajouei (2014) found that 50% of usability problems were considered to be major or catastrophic by users. Similarly, in the current study, more than half of the usability problems were rated as major or catastrophic. The current study also showed that the evaluators mentioned some of the usability problems under different heuristic items. For example, search-related problems were repeated in two heuristics concerning the visibility of system status and user control and freedom. These results are similar to those of previous studies (Zhang, Johnson, Patel, Paige & Kubose, 2003; Granizo, Yanez, Ramirez & Machado, 2011) which reported that one usability problem might be violated under multiple heuristic items. Besides, the participants in the current study rated the same usability problems with a different severity. For example, while some of the participants reported a specific usability problem to be minor or major, some others considered the same problem to be catastrophic.

Accessibility is another critical factor that needs to be considered for all users including those with disabilities during the development process of a website. For the accessibility evaluation, the 10 selected Libyan government websites were evaluated using automation tools according to the WCAG 2.0 criteria. The results showed that only the Management of Scholarships website had no accessibility errors and passed the accessibility evaluation in AChecker; however, remainder of the Libyan government websites failed the evaluation. These results seem to be consistent with those reported in many previous studies demonstrating that government websites had critical accessibility problems and failed the accessibility evaluation (e.g., Sun & Chen 2010; Al-Radaideh, Nuser and Wahbeh, 2011; Al-Khalifa 2012; Adepoju,

Shehu & Bake, 2016). Therefore, it can be concluded that it is very difficult for Libyan citizens, particularly those with disabilities, to use the government websites in an effective, efficient and satisfactory way.

More specifically, according to the AChecker tool, none of the Libyan government websites passed conformance level A except the websites of the Management of Scholarships and Ministry of Higher Education & Scientific Research. Furthermore, the results of the TAW tool showed that even these two websites did not pass conformance level A. If a website satisfies the minimum requirements; i.e., conformance level A, then the remaining conformance level errors need to be evaluated in order. The TAW tool did not report any conformance level AA errors; however, all the government websites had accessibility errors concerning conformance level AAA. Six government websites passed conformance level AA, and 7 passed conformance level AAA using the AChecker tool. Similarly, Baowaly and Bhuiyan (2012) evaluated the accessibility of 10 government websites in Bangladesh and reported that all the selected websites failed conformance levels A, AA, and AAA in AChecker and five websites did not satisfy conformance level A, but met the criteria for conformance levels AA and AAA.

The results of the current study demonstrated that checkpoint 1.1.1 was most frequently violated at conformance level A according to the AChecker and TAW tools. This checkpoint was related to providing text alternatives for each non-text element. Using alternative text is very critical for people with visual impairments to understand the non-text content of a website and use that website effectively with assistive technologies. Similarly, most previous studies (e.g., Al-Khalifa, 2010; Latif

& Masrek, 2010; Isa, Suhami & Safie, 2010; Ismailova & Inal, 2016) pointed out that this checkpoint was mostly violated according to the results of their accessibility evaluation. Checkpoints 1.3.1 (on information and relationships), 2.4.4 (on the purpose of each link) and 4.1.1 (on parsing) were also found to be most violated at conformance level A using the TAW tool. These results are consistent with those of Ismailova and Inal (2016), who evaluated the government websites of the Kyrgyz Republic and the Republics of Kazakhstan, Azerbaijan and Turkey. The authors concluded that the evaluated websites mostly failed these checkpoints.

In the current study, two most commonly used and popular accessibility evaluation tools, AChecker and TAW, were utilized for the accessibility evaluation. The results of the study showed that each tool produced different evaluation data in terms of the accessibility of the same government websites. The TAW tool reported more accessibility problems compared to the AChecker tool. In certain checkpoints, there were also very large gaps between the results derived from these tools. For example, while AChecker reported no accessibility error for a Libyan government website, TAW identified several accessibility problems. Similarly, the Management of Scholarships website passed all three conformance levels (A, AA, and AAA) using the former, but had many accessibility errors according to the latter. This confirms the results reported by Tashtoush, Darabseh and Al-Sarhan (2016), who underlined the differences between automation tools in terms of the results of accessibility evaluation. Therefore, it can be suggested that in order to provide consistency and obtain reliable data from accessibility automation tools, different tools should be utilized.

CHAPTER 6: CONCLUSION

E-government websites are becoming increasingly important for providing public services and information to citizens. Ensuring access for all people and offering ease-of-use should be the main targets of any government website. This study focused on the accessibility and usability evaluation of 10 Libyan government websites. Based on the findings, it can be concluded that it is very difficult particularly for people with disabilities in Libya to use the evaluated government websites effectively, efficiently, and satisfactorily. Besides, the Management of Scholarships website had critical usability problems that prevented citizens from adequately benefitting from government services. As a result, authorities, administrations, and developers need to place more emphasis on the usability and accessibility issues of government websites in Libya in order to ensure equal access to all the citizens.

In this study, accessibility evaluation was carried out utilizing online evaluation tools. Although automated evaluation tools provide valuable data on the accessibility of a website, understanding users' needs and expectations is also very critical to evaluate a website. Therefore, the main limitation of accessibility evaluation in this study was using only automated evaluation tools. In the context of future work, target groups including the disabled and elderly people from Libya can be selected to evaluate the accessibility of the government websites in the country. For the usability

evaluation, only the Management of Scholarships website was evaluated by a limited number of Libyan participants; thus, for future work, other government websites can be tested with a large number of evaluators to identify usability problems. Furthermore, in addition to heuristics evaluation, different usability evaluation methods can be utilized to provide a better understanding of the usability problems.

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APPENDICES

APPENDIX A: Demographic Questionnaire

Questionnaire about Identifying the Mostly Used Libyan Government Websites

1. Age: _____

2: Gender: _____

3: Level of Education:

O Secondary School Degree

O Bachelor Degree

O Higher Diploma

O Master Degree

O PhD Degree

4: Which of the following Libyan government websites do you visit most often?

O Management of Scholarships

O National Number Project

O Ministry of Higher Education & Scientific Research

O Ministry of Culture & Civil Society

O Ministry of Finance and Planning

O Ministry of Interior

O Ministry of Foreign Affairs

O General Authority for Communications and Informatics

O Ministry of Defense

O Ministry of Agriculture, Livestock and Marine

5: How frequently do you visit this website?

O Daily

O 3-4 times a week

O Once a week

O Once a month

APPENDIX B: AChecker Tool Results

Websites	Level A	Level AA	Level AAA	Total # of Errors
Management of Scholarships	0	0	0	0
National Number Project	5	0	16	21
Ministry of Higher Education & Scientific Research	0	21	0	21
Ministry of Culture & Civil Society	8	0	0	8
Ministry of Finance and Planning	6	3	0	9
Ministry of Interior	6	8	1	15
Ministry of Foreign Affairs	33	0	119	152
General Authority for Communications and Informatics	37	0	0	37
Ministry of Defense	10	0	0	10
Ministry of Agriculture, Livestock and Marine	10	4		14

Websites	Conformance Level A					
	Checkpoints					
	1.1.1	1.3.1	2.4.4	3.1.1	3.3.2	4.1.1
Management of Scholarships	-	-	-	-	-	-
National Number Project	3	-	-	2	-	-
Ministry of Higher Education & Scientific Research	-	-	-	-	-	-
Ministry of Culture & Civil Society	5	1	1	-	1	-
Ministry of Finance and Planning	-	-	5	-	1	-
Ministry of Interior	3	2	-	-	1	-
Ministry of Foreign Affairs	26	3	1	2	1	-
General Authority for Communications and Informatics	2	-	32	2	-	1
Ministry of Defense	-	6	-	1	3	-
Ministry of Agriculture, Livestock and Marine	10	-	-	-	-	-

Websites	Conformance Level AA						
	Checkpoints						
		1.4.4	**2.4.6**				
Management of Scholarships		-	-				
National Number Project		-	-				
Ministry of Higher Education & Scientific Research		18	3				
Ministry of Culture & Civil Society		-	-				
Ministry of Finance and Planning		2	1				
Ministry of Interior		8	-				
Ministry of Foreign Affairs		-	-				
General Authority for Communications and Informatics		-	-				
Ministry of Defense		-	-				
Ministry of Agriculture, Livestock and Marine		3	1				

Websites	Conformance Level AAA						
	Checkpoints						
		1.4.6					
Management of Scholarships		-					
National Number Project		16					
Ministry of Higher Education & Scientific Research		-					
Ministry of Culture & Civil Society		-					
Ministry of Finance and Planning		-					
Ministry of Interior		1					
Ministry of Foreign Affairs		119					
General Authority for Communications and Informatics		-					
Ministry of Defense		-					
Ministry of Agriculture, Livestock and Marine		-					

APPENDIX C: TAW Tool Results

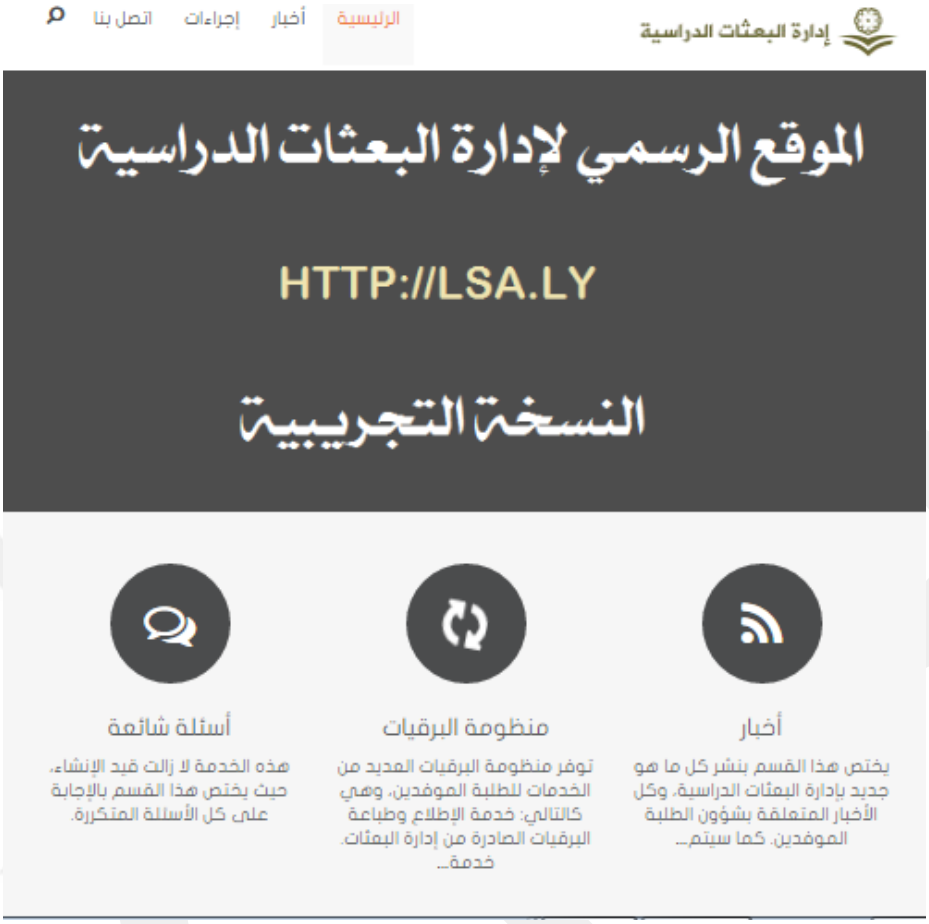
Websites	Level A	Level AA	Level AAA	Total # of Errors
Management of Scholarships	34	0	7	41
National Number Project	8	0	1	9
Ministry of Higher Education & Scientific Research	27	0	9	36
Ministry of Culture & Civil Society	22	0	1	23
Ministry of Finance and Planning	59	0	4	63
Ministry of Interior	57	0	47	104
Ministry of Foreign Affairs	60	0	1	61
General Authority for Communications and Informatics	48	0	3	51
Ministry of Defense	84	0	41	125
Ministry of Agriculture, Livestock and Marine	33	0	10	43

Websites		Conformance Level A						
		Checkpoints						
	1.1.1	1.3.1	2.4.4	3.1.1	3.2.2	3.3.2	4.1.1	4.1.2
Management of Scholarships	6	8	8	1	-	-	11	
National Number Project	-	4	-	1	-	-	2	1
Ministry of Higher Education & Scientific Research	1	20	-	1	-	1	3	1
Ministry of Culture & Civil Society	12	1	7	1	1	-	-	-
Ministry of Finance and Planning	2	8	20	-	2	2	23	2
Ministry of Interior	17	18	11	1	-	1	5	4
Ministry of Foreign Affairs	23	4	22	1	1	3	3	3
General Authority for Communications and Informatics	1	2	32	1			12	
Ministry of Defense	17	21	13	1	1	4	22	5
Ministry of Agriculture, Livestock and Marine	1	8	10	1			13	

Websites	Conformance Level AA						
	Checkpoints						
		1.4.4	2.4.6				
Management of Scholarships	-	-	-	-	-	-	-
National Number Project	-	-	-	-	-	-	-
Ministry of Higher Education & Scientific Research	-	-	-	-	-	-	-
Ministry of Culture & Civil Society	-	-	-	-	-	-	-
Ministry of Finance and Planning	-	-	-	-	-	-	-
Ministry of Interior	-	-	-	-	-	-	-
Ministry of Foreign Affairs	-	-	-	-	-	-	-
General Authority for Communications and Informatics	-	-	-	-	-	-	-
Ministry of Defense							
Ministry of Agriculture, Livestock and Marine							

Websites	Conformance Level AAA						
	Checkpoints						
		1.4.6	2.4.9	2.4.10	3.1.1		
Management of Scholarships	-	-	5	2	-	-	-
National Number Project	-	-	-	1	-	-	-
Ministry of Higher Education & Scientific Research	-	-	6	3	-	-	-
Ministry of Culture & Civil Society	-	-	-	1	-	-	-
Ministry of Finance and Planning	-	-	-	4	-	-	-
Ministry of Interior	-	-	38	9	-	-	-
Ministry of Foreign Affairs	-	-	-	1	-	-	-
General Authority for Communications and Informatics	-	-	2	1	-	-	-
Ministry of Defense			23	18			
Ministry of Agriculture, Livestock and Marine			4	6			

APPENDIX D: Screenshots of Evaluated Government Websites



Homepage of Management of Scholarships Website

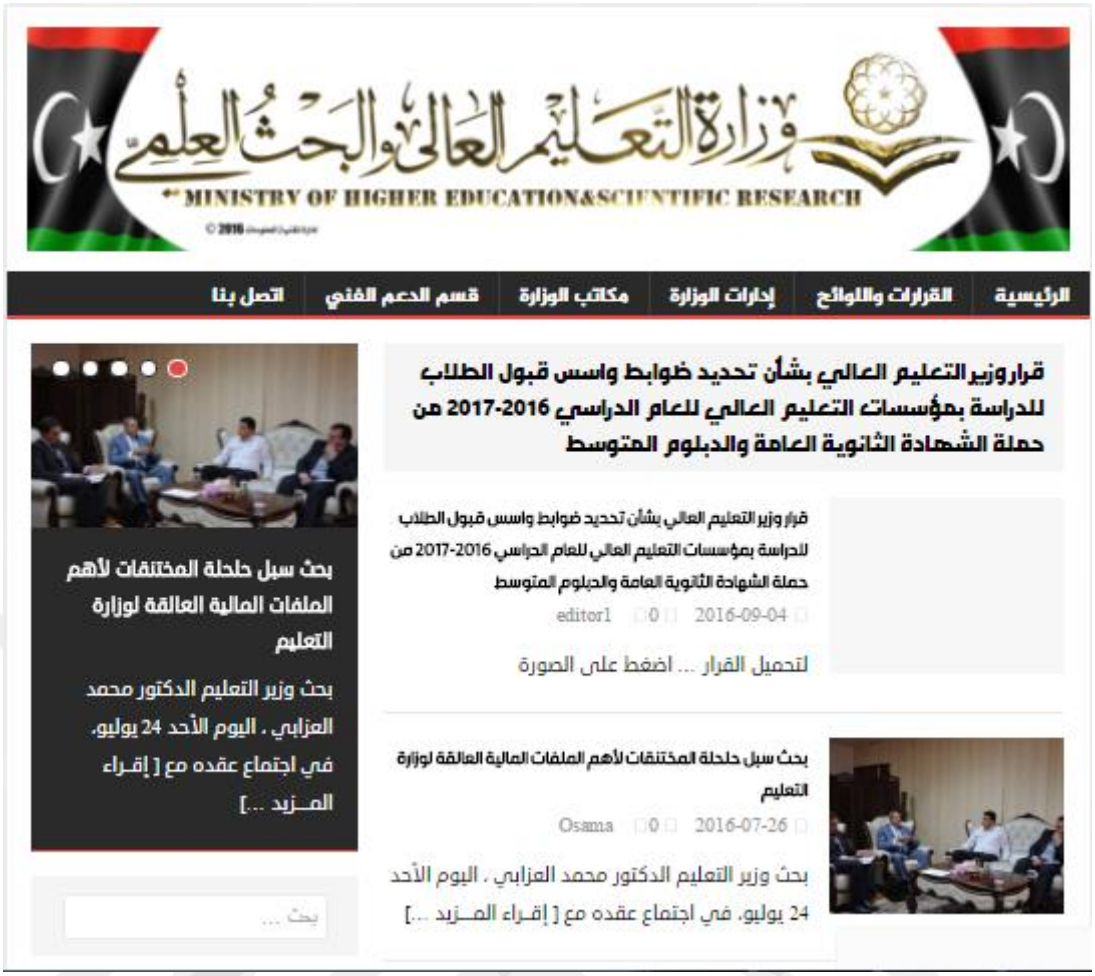
http://lsa.ly/home

This website is for students who are studying abroad by the Ministry of Higher Education & Scientific Research and Management of Scholarships. Also it has sub-tabs such as news which are about their studying and it has a system which called mail tracking system. Each student who is studying abroad has account on this system, whereas she/he can track her/his mails through it.

Homepage of National Number Project Website

http://www.nid.gov.ly

From this website, citizens can get the national number and other services such as reserve an appointment to make new passport.



Homepage of Ministry of Higher Education & Scientific Research Website

http://www.highereducation.gov.ly

This website is specially made for students who study in higher institutes and universities inside Libya and, people who work in them. The website has some tabs such as news, decisions and regulations and others. In addition, the website has links for Libyan universities and institutes.

Homepage of Ministry of Culture & Civil Society Website

http://www.culture.gov.ly

This website is about culture and arts in Libya. From this platform, Libyan people can get some documents related to civil society institutions.

Homepage of Ministry of Finance and Planning Website

http://www.mofp-ly.com

This website is a special for the country's own financial matters. The website includes decisions that developed by the Ministry, news of revenues and financial activities which carried out by the Ministry of Finance and Planning.

Homepage of Ministry of Interior Website

http://moi.gov.ly

Ministry of Interior Website is for the security of the homeland and the citizen. The website contains tabs like news and services which include details about the services provided by the Ministry and another tab which has decisions that developed by the Ministry.

Homepage of Ministry of Foreign Affairs Website

http://www.foreign.gov.ly/

This platform is responsible for regulating foreign relations and diplomacy with other countries such as organizing issues of migration. The platform has tabs such as speeches and declarations tab published by the Ministry and news tab for foreign policies that related to the country.

Homepage of General Authority for Communications and Informatics Website

http://www.cim.gov.ly

This website is responsible for the telecommunications sector in Libya. The website gives a general idea about communications. Moreover, the website contains several tabs which include electronic services tab and organize communications tab which contains procedures, models, relying qualitative and other options. the homepage of the website has bar for news.

Homepage of Ministry of Defense Website

http://www.defense.gov.ly/

This website is a special for Ministry of Defense that is responsible for development and rehabilitation of the armed forces. The website contains all news that concerns armed forces and decisions developed by the Ministry of Defense and other multiple tabs.

Homepage of Ministry of Agriculture, Livestock and Marine Website

http://agriculture.gov.ly/

This website is a special for Ministry of Agriculture Livestock, and Marine. The website is professional news website which includes news and activities of the agriculture, livestock and Marine sector. This website contains several tabs which include administrations, offices and affiliates for this ministry.