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# Exploring the Relationship between Web Usability and the Web Accessibility Guidelines

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**Abstract:** Web becomes more complex with the fast growth of application. The various web accessibility guidelines have been promoted since their inception and even demanded high level to help improve accessing, understanding and operating the content of web pages. Usability engineering has made its approach into the World Wide Web mainstream that focuses on how the end users will work to achieve their target goals. Some web based usability challenges are not kept in mind while designing web-based application by implementing various web accessibility standards. This study focuses on identifying the gap between usability and three web accessibility standards (WCAG 2.0, ISO 9241:151 and Section 508). The research aim is to evaluate how the usability challenges of web-based application are related to web accessibility guidelines.

**Keywords:** Usability; user-centered design; web quality standards; web accessibility.

## 1. INTRODUCTION

Everyone knows that nowadays web development is nothing else but a separate highly developed industry that sets and dictates its own web development standards and rules. From a software engineering viewpoint, accessible web sites are becoming increasingly important. The web offers to modern organizations many new opportunities as well as many challenges (Mitra, and Cohen, 1998). Web makes it easy to transmit information in a timely fashion. Web pages can include larger amounts and a greater variety of information without incurring major printing and distribution costs (Chaomeng, 2002) Furthermore, multimedia objects, including drawing, photographs, animation, sound, video, and computer applications, can be integrated into web pages at a low cost to enhance the web's communication effects. However, one characteristic of the web that sets web development apart from traditional media design is the lack of control. A web designer somewhat loses control over how on-line users will browse through the pages, the appearance of the fonts and colors used on a page, and the size, proportions and exact locations of the different web texts ( Nielsen 2010) argues that web sites tend to be produced by young designers, who often assume that all users have perfect vision and motor control, and know everything about the web. Therefore, web content should ideally be designed in a way that the users using different agents with different browsers. Companies invest in new web groups have created web design standards to connect usability practice around the world. However, access sites because the web is now the platform for doing business efficiently and quickly. The majority of global companies will quickly adopt several technology-related aspects of Web 2.0, but the result will be a slow impact on business due to slow to adopt the aspects of Web 2.0 that have a social dimensions (Pettey, 2010). Customer and end users is one of the key factors, to satisfy them, a web site must fulfil some common needs: availability, responsiveness and clarity. The role of usability is to make the products user responsive and design in a way to satisfy users during their use in an effective and efficient manner. E-commerce is the latest development that attempts to influence customers that technology will make their lives easier. Customers of e-commerce websites are suffering from 'technological Tourette's syndrome' throughout the world (Travis. 2003). Real Tourette's syndrome Sufferers have a compulsion to swear, twitch and shout. In addition, customers of e-commerce sites often act the same way. By following the human-cantered design process, project managers, designers and developers can ensure that systems will be effective, efficient and satisfying for customers (Travis, 2010). The main aim of accessibility is that everyone can benefit of a design of a website that represent high quality. Usability has a similar concept, whereas its main objective is for the end-users to be able to learn and use a product to achieve their goals efficiently, and with satisfaction. Therefore, web design should consider both aspects usability and web accessibility. Various to the web applications cannot be taken for granted (Quesenbery, 2005). This paper attempts to explore

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these finding into convincing agreement by addressing the following research questions:

RQ1: what are the usability impacts of web accessibility guidelines?

RQ2: what are the usability issues in web accessibility guidelines that guarantee universal design?

The objective of this study is to understand the concept of usability engineering in web application and to explore the web accessibility standards and finally to evaluate the usability challenges of the web application from the usability guru Jared Spool (2010). The Web Content Accessibility Guidelines 2.0, ISO 9241: Ergonomics of Human-System Interaction; Part 151 Guidance on World Wide Web user interfaces and the Section 508- §1194.22 (Web-based intranet and internet information and applications).

The rest of the paper is organized as follows: Section 2 discusses characteristics and challenges about usability in web application and user centered design concept and provides some insight on the three web accessibility standards (WCAG 2.0, ISO 9241: 151 and Section 508). Section 3 presents some related work and, In Section 4 the approach is discussed. In section 5, the role of usability challenges within these three web accessibility standards is evaluated. Section 6 presents summary of the evaluation. Finally, the study is concluded and leaves an open issue.

## 2. MATERIAL AND METHODS

In this section, we use the literature to present some background on usability and the web accessibility

### *2.1. Usability and the User-Centered Design*

Usability is defined as the degree to which users can perform a set of required tasks to achieve the target goals (Brinck, *et. al* 2002). According to ISO 9241-11. *"usability is 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.*" The first step should be to recognize target user to accomplish their goals in a clear manner. Effectiveness and efficiency then progress as the accuracy and completeness that users use to achieve particular goals. Satisfaction is the encouraging attitudes of the users, towards the use of the artifacts. It is also significant to consider the context of use when designing for usability as effectiveness, efficiency, and level of user in one domain would have different expectations in another domain. A key attitude for carrying out usability is called User-Centered Design. According to (Vredenburg *et al.* 2002), the six core UCD principles, which correspond to the heart of UCD are; Set business goals, Understand users, Design the total customer experience, Evaluate designs, Assess competitiveness and Manage for users. Typical UCD activities by Usability Professional Association (UPA) are broken down into four phases: Analysis, Design, Implementation and Deployment. Usability in the context of web application does not covered only user interface rather includes the content or the information, and functionalities that application could perform. Usability is not a single property of use interface but consists of the following five factors (Nielsen, 1994, Hussain, 2012).

**Ease of learning** – the system should be easy to learn sufficiently well to accomplish basic tasks.

**Efficiency of use** - Once an experienced user has learned to use the system, a high level of productivity should be possible.

**Memorability** - without having to learn everything all over again the system should be easy to remember so that next time the user returns to the system the user should be able to it effectively use the system enough.

**Error frequency and severity** - If the users do make errors, they can easily recover from them and the catastrophic errors must not occur if all other measures fail.

**Subjective satisfaction** - The user must experience satisfied with the system.

According to the (Spool, 2007), there are also five major usability challenges that every web-based application developer face. They are:

**Scalability:** The application should be scalable enough so that it is able to taking care and serves the users as the number of users increase. This is not to consider respond time of the application but also includes the management and control of the content that would rapidly grow over time and as the user increased as well. Web designers need to take both the scale of the user base and the scale of the data into account when thinking about how to design their web-based applications effectively (Spool, 2007).

**Visual Design:** According to (Wroblewski, 2006), visual design is all about communication. The better is the communication, the easier it is for users to use and appreciate the well design web sites. Visual design should cover suitable layout, media and information presentation, as well as the navigation through and functionalities of the application.

**Comprehension:** The application is considered useless even it easily and properly operate, but not understandable by the user, hence fail the user and cannot use effectively. Web application are there to assist the user to accomplish task, understanding the functionalities and information offered by the application.

**Interactivity:** From user point of view interactivity is the big difference between a regular web pages and the web application. Learn how to interact is crucial for the user because time spending on keying in information or figuring out the content. User is also concerned about the irregular path followed in the application.

**Change Management:** The nature of a user is to always resist changing. Hence, to achieve the usability of the web careful planning is needed for change management.

In designing usable web-based application, the content details are considered as devil, to create a usable web application the above usability challenges makes it different from other types of design

*2.2 Web Accessibility guidelines*

Based on the different point of views there are various definitions of web accessibility. According to Henry, (S. L 2005), "Web accessibility means that people with disabilities can use the web". Disable people can face experience more difficulties using the web than normal users do. In order to ensure that the disabled people are able to benefit from the Web, the web accessibility for disabled people has been an issue of growing concern worldwide. According to ISO 2008 accessibility is defined as the "*usability of a product, service, environment or facility by people with the widest range of capabilities"*. There are varieties of guidelines and tools to allow web accessibility but the most relevant ones are W3C, ISO and Section 508.

*2.2.1 WCAG 2.0 (Web Content Accessibility Guideline*

W3C or World Wide Web Consortium is an international consortium. So far, there are plenty of web standards and recommendations launched by W3C such as WCAG 2.0. The purpose of WCAG 2.0 is to facilitate the disabilities, to help access, retrieve, understand, and operate the information, content, and media presented within web pages According to the four principles the web content should be. Perceivable, Operable, Understandable, Robust. (W3C, 2008) The principle "Perceivable" guides, the users should be able to perceive the user interface components. Guideline of "Operable" principle discusses how the interface should be operating, or how the presentation should guide the user to navigate. The characteristic "Understandable" means the information should be understandable by the user. The name "Robust" describes that the information should be compatible enough to be accessed and interpreted in the same way by the variety of users

*2.2.2. ISO 9241-151:2008, Ergonomics of Human-System Interaction: Guidance on World Wide Web user interfaces*

The usability aspect of ISO 9241:2008 falls into the part of 151 – Guidance on World Wide Web user interface, which discuss on the usability of web application's user interface. ISO 9241-151 focuses on the design aspects, and provides design guidance and recommendations in four major areas described by Bevan, (2005) which is:

Purpose and strategy
Content and functionality
Navigation and interaction
Media design and presentation

Purpose and strategy discusses about the purpose of web application. Content and functionality is about in the conceptual aspect of how the content has been organized, as well as how the web application influence and handle the issue of privacy, personalization, security, etc. Navigation and interaction level present the feature of how the content and the site itself should be structured in such a way that user can navigate through and achieve their objectives easily. Presentation and media design component seems to be the most realistic level. Presentation of information shall be presented in the best suitable forms for the users" benefits.

*2.2.3 Section 508*

Section 508 of the Rehabilitation Act applies to the federal agencies (Section 508), which require that e-government web sites to be accessible to people with disabilities. Under Section 508 (29 U.S.C. '794d), federal agencies must provide information to disabled persons compare to the access available to normal persons. The specific technical standards addresses (Section 508) Software applications and operating systems (1194.21) Web-based intranet and internet information and applications (1194.22) Telecommunications products (1194.23) Video or multimedia products (1194.24) Self-contained closed products such as copiers (1194.25) Desktop and portable computers (1194.26) Our interest is in §1194.22 (Web-based intranet and internet information and applications), standards for the implementation and web site design. The criteria for web-based information is based on web accessibility initiative (WAI) developed by World Wide Web Consortium (W3C). The 16 guidelines of the Internet and Intranet Accessibility Standards address the accessibility needs of persons with disabilities (Section 508).

**Related Work**

It is very difficult to create web standards to represent usability practice. The quality of web sites is often inadequate, and web designers hardly consider basic web principles, such as interoperability and

accessibility. Studies have shown that accessibility of website especially federal e-government sites, did not sufficiently examine the web site accessibility issues. For example, Section 508 does not be valid to various web sites that may perhaps be required to be accessible by other laws. Web usability has become one of the key success factors due to the rapid growth of web application worldwide (Quesenbery, 2005, Boldyreff, 2002, Jaege, 2004), analyzed three well-known usability standards ISO 13407– Human-centered design process for interactive systems, ANSI 354 – Common Industry Format (CIF) for Usability Test Reports, WAI –The goal of all the usability standards is to increase the level of usability of the web application but these standards are limited in scope.

Boldyreff, (2002) has proposed an accessibility framework from Computer Supported Co-operative Work research and the ISO standard, ISO/IEC 9126 on software quality using layered evaluation framework consisting of reliability, efficiency, maintainability, efficacy, usability and functionality. The goal of the accessibility framework is to provide web developers with a useful basis for taking into consideration web accessibility through the development of a set of accessibility factors related with each identified layer.

Signore, (2005) also proposed a quality model relating internal and external quality factors and presenting signs about potential problems, which are measured by automated tools. The five dimensions considered by the quality model are correctness, presentation, content, navigation and interaction. The proposed quality model can be useful to fix errors through re-engineering.

Jaeger, (2006) has analyzed the variety of federal laws that create legal requirements for accessible e-government web sites. The author also discussed the multi method user-centered study of the accessibility perceptions of federal e-government sites that addresses the complexities reasons of accessibility. The result shows that the further improvement is needed between e-government Web sites and user's channel of communication. The different barriers identified to accessibility for persons with disabilities are a serious problem. (Hussain *et. al* 2011), proposed using English alphabets a text scheme using and the results showed that the web reading comprehension in improved for non-native English speakers. The authors also compare the three different web accessibility guidelines WCAG 2.0, IBM 5.1 and Section 508 against the Nielson readability characteristics. (Sohaib *et al.,* 2011) evaluated characteristics of user experience (UX) related to web application and the results shows that it is important to consider the different usability challenges while designing web pages. Designing web applications presents some major challenges Spool, (2010), compare to other types of designs. Therefore, there is a need to keep in mind those challenges while designing web applications.

**The Approach**

The aim of this work is to find the practical gap, whether the web quality standards meet the Spool usability challenges Spool, (2010) in web applications or not and to what extent it may be successful. The focus of the study is many online references and related literature that work as a basis for suggestion. In this evaluation, The five usability challenges according to Spool (2010) in web application as discussed in section 2.1 are; Scalability, Visual Design, Comprehension, Interactivity and Change Management are in consideration with the web standards WCAG 2.0, ISO 9241-151:2008 and the Section 508 covering only §1194.22 (web-based intranet and internet information and applications).

**Evaluations**

To give an indication of the current situation of the web accessibility with the focus on Spool usability challenges in web-based application (Spool, 2011). We will analyze the challenges of usability in web application and the three web quality standards.

*5.1 Usability Challenge 1 - Scalability*

The WCAG 2.0 covers the aspect of controlling the content and information, when the users spend time interacting with website. WCAG 2.0 absorb scalability of user, how to face the user expansion not only in the sense of hardware and network infrastructure but also in the sense of data presentation and content accessibility as the number of user increases. The WCAG 2.0 guidelines were designed intentionally with scalability in mind. ISO 9241-151 and section 508- §1192.22 alone does not cover this aspect, rather than consider as a whole series of ISO 9241 and Section 508.

*5.2 Usability Challenge 2 - Visual Design*

The visual design and pleasant of the user interface is one of the significant challenges in developing web application. WCAG 2.0 compliant website does guarantee the success over this challenge. The use of color (WCAG 2.0 criterion 1.4.1), minimum contrast (WCAG 2.0 criterion 1.4.3) and visual presentation (WCAG 2.0 criterion 1.4.8) are the beauty of user interfaces Dawson, K (2009). In addition, Section 508-§1192.22 (paragraph b & c) focuses that design of web pages are, that conveyed all the necessary information. However, ISO 9241-151 on

the other hand takes an advantage of generic statements and not specify any definite guidance, but also not enough to have a good visual design and nice interface though.

*5.3 Usability Challenge 3 – Comprehension*

This challenges could be passed easily if the website conform to WCAG 2.0, ISO 9241-151 and Section 508 recommendation, as their strength in focusing the content readiness, understandability, navigation, interaction, response and perceivable. According to Rubinoff (2004), the structure of content (text, images, multimedia) reflects the comprehensibility and readiness of the website. WCAG 2.0 offers support of comprehension, For-example guideline 3.3 (input assistance) describing the error identification and prevention. The Section 508-§1194.21,For-example (paragraph n) comprehend the users by giving all direction and clues. ISO 9241-151 also providing more complete set of guideline supporting comprehension, For-example (C) Relevance-based ranking of search results and Providing cross linking to potentially relevant content.

*5.4 Usability Challenge 4 – Interactivity*

Interactivity is one of the strengths of WCAG 2.0, ISO 9241-151 and Section 508-1192.22 due to the understandability of the content and operability. Particularly ISO 9241-171:2008 is related to the accessibility of interactive system, However ISO 9241-151: 2008 also assist users by guidelines that are more precise.. Interactivity in WCAG 2.0 is supported particularly by providing time and helps users to navigate where they are (Guideline 2.2 Enough time, and 2.4 Navigable). The Section 508- § 1194.21 also support interactive elements by giving sufficient time where time response is required. The gap between this usability challenge in web application and standards regarding the issue is none.

*5.5 Usability Challenge 5 - Change Management*

There is no direct discussion toward the change management in WCAG 2.0, ISO 9241-151 and Section 508-1192.22, rather just change avoidance in WCAG 2.0. For-example section 3.2.1 of WCAG 2.0 predictable guideline suggests the developer not to change but rather strict to consistent of functions and mechanisms; which shows the change avoidance proposed by WCAG 2.0. However, none of the standard suggests, how to introduce change management to the end-user. Considering the change management as the most significant confront in every domain that involves human, all the three quality standards can be considered as failure.

## 3. RESULTS AND DISCUSSION

There are perfect set of guidelines for the web designer, if they know their target users. On the other hand, the quality standards in the internet industry are in abundance, the right standard that is effective and efficient enough to fulfill needs of end users can be chosen. This study not only provide evaluation of web accessibility standards with respect to usability challenges but also suggest a useful direction for the web designer, developers that are interested in developing highly usable web site or web based application for both disable and non-disable persons. Evaluating the gap between the usability in web application and the quality standards, the result shows that the WCAG 2.0 is able to meet the basic demand of end-users more than the ISO 9241-151: 2008 and Section 508-1192.22, as summarized in **(Table 1).**

**Table-1. Summary of Evaluations.**

| Jared Spool Usability challenges | WCAG2.0 | ISO 9241:151 | Section 508-1192.22 |
|---|---|---|---|
| Scalability | Yes | No | No |
| Visual design | Yes | No | Yes |
| Comprehension | Yes | Yes | Yes |
| Interactivity | Yes | Yes | Yes |
| Change Management | No | No | No |

## 7 CONCLUSION AND FUTURE WORK

In this paper, we have evaluated web quality standards criteria against the spool usability challenges. There are different types of web application including transactional, social web, collaborative, ubiquitous, and semantic and many others. Many organizations are continuing to extend the functionalities of their web-based systems due to the rapid growth of mobile technology. Effective usability becomes also important for the design of web-based application. Therefore, it is important to develop and adopt suitable web design guidelines while keeping in mind the usability challenges. As per conclusion, the study examined various usability challenges in web accessibility guidelines that guarantee end-user satisfaction. However, those usability challenges have not been widely recognized by the World Wide Web accessibility industry. The various web accessibility standards aim to develop quality accessible website to satisfy the disable and non-disable internet users. However, quality attributes also depends upon usability. Usability in web application can be recognized from many groups of challenges and characteristics, some challenges we have applied in this study, however many more are still waiting to explore.

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