Subjective Evaluation of Website Accessibility and Usability: A Survey for People with Sensory Disabilities

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ABSTRACT

A novel subjective evaluation model for accessibility is developed utilising a questionnaire survey approach, with reference to the characteristics of disabled groups and the features of university websites. Measuring accessibility, including through usability evaluations, is an important equity step in assessing and improving the effectiveness and usefulness of online learning and general materials for students with disabilities. The popular uptake of blended and online learning warrants an evaluation of the accessibility of web-based university websites for equity in access to quality learning experiences and outcomes. The model conforms to user-centred design theory and is designed on the basis of usability and accessibility statements derived from contemporary accessibility questionnaires and standards. The model is applied to evaluate Australian university web-based systems. The initial data show that 55% of students with sensory disabilities believe the accessibility of their current website content negatively affects their study, and 70% believe the web pages are not well structured for navigation by learners with sensory disabilities.

CCS Concepts

•Human-centred computing •Accessibility •Accessibility design and evaluation methods

Keywords

Accessibility evaluation; Usability evaluation; User-centred design (UCD); Assistive technologies; Subjective evaluation; Sensory disabilities; University websites

1. INTRODUCTION

Accessibility and usability are strongly related [1]. Considering usability as a subcomponent of accessibility may open up prospects for logical solutions that ensure usability as an integrated part of each accessibility program. The challenge that confronts university web page design is the exploration of user interfaces that offer technological variety (such as WEB 2 components and graphical interfaces) and promote the development of user knowledge and user diversity in lieu of a one-size-fits-all solution. Accessibility and usability are therefore key components in providing excellent user experiences in web-based system interactions.

An effective framework for ensuring the reliability and efficiency of accessibility evaluations can be founded on an analysis of a

sample population of users' subjective appraisals [2]. Subjective assessment is based on the needs, characteristics and experiences of principal stakeholders as they interact with a web-based system [3]. The accuracy of measuring the accessibility of university systems can be increased by optimizing students with disabilities experiences and expectations of real-world interactions with multi-media content, document files and assistive software and by eliciting their reflections on general experience [2]. Understanding the characteristics of users with disabilities, e-learning system features and functions, and then mapping the relationship to state-of-the-art accessibility and usability guidelines and standards using relevant questionnaires (e.g. WCAG 2.0, SUMI, SECTION 508 and IBM) will contribute to a disability-specific accessibility and usability evaluation tool. The evaluation tool can be used by stakeholders (learners, etc.) to subjectively evaluate web-based systems such as universities' websites.

In the following sections, we provide the details of developing a novel subjective evaluation model to apply to evaluations of universities websites from the perspectives of users with disabilities.

2. RELATED WORK

The literature has been reviewed to identify the main issues for investigation related to WEB accessibility and the use of assistive technology by deaf and visually impaired users. In this section, more details are provided about subjective evaluation methodology in respect to accessibility and usability, with an emphasis on the accessibility of university websites.

2.1 Subjective Evaluations

Subjective evaluation is part of user-centred design (UCD) and is based on the needs, characteristics and experiences of principal stakeholders as they interact with a web-based system. Questionnaires and observations are the most frequently adopted methods of assessing stakeholder perceptions. These methods are used in practical and theoretical projects [2].

Treating accessibility and usability as being positioned in a certain hierarchy can create delays in the review and resolution of accessibility problems in the design of new and existing systems. By integrating these two concept areas, developers can provide interactive services that can be accessible and user-friendly for all users, including people with disabilities [4].

A challenge in developing accessible, usable web-based systems is determining what standards to conform to, what methods to deploy and what changes to apply in current systems [5]. These issues may be addressed through UCD-based instruments, such as the Software Usability Measurement Inventory (SUMI) [5], and IBM's computer usability satisfaction questionnaires [6]. Similarly, accessibility instruments such as the Web Content

Accessibility Guidelines (WCAG 2.0) [7] and the Section 508 standard [8] are useful. These instruments help developers prioritize standards and issues for resolution on the basis of feedback provided by core users; decide on initial and succeeding changes to systems; and select the standards or guidelines, evaluation tools, learning resources, system functions and tasks that are most suited to the needs and characteristics of students with disabilities [9].

2.2 Accessibility of University Websites

Accessibility evaluation is an important equity step in assessing the effectiveness and usefulness of online learning materials for students with disabilities. In a recent empirical study [11], researchers assessed the websites of 60 top universities in the world and in Oceania and Arab regions. They found 30,944 (37%) home page errors in 180 evaluated pages. The study indicated access to media and document files revealed the most critical accessibility errors. Moreover, of all users with disabilities, visually impaired individuals are most strongly affected by inaccessible educational systems [12]. Fichten, Jorgensen, Havel and Barile demonstrated that most students indicated that they need adaptive assistive technologies, such as screen readers and voice recognition software, to effectively interact with a university system [13].

In the following section, the phases of designing accessible usable statements for the proposed subjective evaluation model are covered.

3. DESIGN OF ACCESSIBLE AND USABLE STATEMENTS

The phases of designing accessible and usable statements align with understanding evaluation goals, user characteristics and system features and involves mapping the relationship between accessibility and usability.

3.1 University Website Features

The past two decades have witnessed the substantial development of online learning, with such progress prompting organisations, educators, students and legislators to pay increasing attention to evaluating and enforcing accessibility in educational websites, including online courses that are managed via learning management system (LMSs) [7,8,10,15,16]. An equity perspective dictates determining whether users who interact with online educational systems are satisfied with system accessibility and compliance and whether such systems provide them the support essential to academic success. An important task in this respect is to identify the strategies that educational organisations can implement to satisfy accessibility guidelines and the needs of their stakeholders. Such tasks cannot be accomplished without incorporating a feedback mechanism through which students with disabilities can evaluate a current website and through which accessibility development plans can be created.

In university websites, a set of information systems that are executed by software programs are used by students. Website, SIDE™, SIDE™, Blackboard™ and DSpace™ are examples of the systems used by students and their purposes in universities. When university administrators measure accessibility rate, they consider all the subsystems in a core system. Accessibility is therefore not exclusive to an LMS but applicable to an entire system.

3.2 Sensory Disability Characteristics Priorities

In this section, we develop a subjective evaluation method to evaluate university websites from sensor disability users: the visually impaired, including those who are blind and have low vision, and hearing groups, including deaf and hard of hearing users [3]. Heuristics eases the identification and prioritisation of characteristics for specific disabled groups. For example, for deaf and hard of hearing users, a missing text description of an image is not a barrier. Figure 1 illustrates the heuristically determined priority characteristics on the basis of each sensory disabled group.

Figure 1. Heuristic priorities based on the characteristics of each sensory disabled group

3.3 Design of Questionnaire Statements Categories

An evaluation of the website experiences of users with disabilities is designed on the basis of a combination of methods presented in the extant literature. This combination consists of WCAG 2.0 as the main set of guidelines, the Section 508 self-evaluation questionnaire as the source of accessibility statements, and SUMI and IBM items as the sources of usability statements. The outcome expected from this combination is an accessibility and usability questionnaire (Figure 2).

Figure 2. Creation of accessible and usable statements

With regard to usability, we used SUMI [6], which is a rigorously examined instrument for measuring system quality from the point of view of core users. SUMI's main statements serve as important criteria that are used in conjunction with accessibility criteria for the purpose of creating the accessible and usable statements employed in our subjective method. SUMI supports our assumption regarding usability, which is considered a subcomponent of accessibility to successfully realise the evaluation method goal. Usability should be regarded as integral to accessibility concepts in evaluating the accessibility of university websites. Moreover, the satisfaction of students with disabilities is the top priority in ensuring accessibility. The design of IBM's user satisfaction questionnaires is based on psychometric methods. The questionnaires will thus be used to determine the sentiments of students with disabilities regarding their interactions with university systems.

With respect to accessibility, the WCAG 2.0 guidelines and the Section 508 self-evaluation questionnaire were examined to ensure that they cover important accessibility issues that affect the performance of students with disabilities; these issues are an accessibility evaluation for non-text elements, the existence of

descriptive texts, the availability of text captions, ease of navigation, the existence of server-side images, the semantics of information, the accessibility of PDF files and forms, response time and accuracy of alternative text-only pages [8]. The outcome of this combination led to defining the first category in the survey questionnaire: ‘general system interaction’. However, in WCAG 2.0 and Section 508, no attention is given to the accuracy and quality of descriptive texts, the rate of appearance of null values in lieu of descriptive texts, the accurate revision of descriptive texts when media elements are updated, whether a publisher or developer has considered in-text explanations of media elements, whether such explanations correctly describe the elements, whether synchronicity exists between descriptive texts and audio or video captions, and whether captions and sign language components or subtitles are accurate [14]. Additionally, the comprehensibility of media content, such as video and audio materials, images, graphs, photos and charts, influences student learning. For these reasons, an accessibility evaluation for media content is considered a main category of our subjective evaluation method: ‘media file issues’.

Also, given that fewer effacements are found in document files, which are prevalent components of LMS interaction and learning content, specific sections will be evaluated to ascertain which document files exert the strongest influence on student interactions. These file types exhibit similarities in accessibility issues, but some are evident in document file type and not in others; for example, the availability of slide titles is a common accessibility issue in PowerPoint files, but not in Excel files [15]. The Section 508 questionnaire includes a general question that is intended to verify the accessibility of PDF files, without the standard specifying issues that may exist in such documents. Numerous PDF files are uploaded into university web-based systems, some of which are created as PDFs, whereas others are converted from Word or PowerPoint files [10]. Blackboard Inc. has noted that students with disabilities identify the accessibility of document files as the top complaint [16]. PDF file standard [10] and accessibility checker rules for Microsoft Office 2013 [15] will be used in conjunction with other standards and guidelines. Document files strongly influence student learning, performance and final achievement, and the accessibility issues that are common to all document files will be considered the third main category: ‘document file issues’.

Assistive software screen readers such as JAWS™, offer accessibility solutions and provide visually impaired users a sense of independence to interact with university websites. Also, voice recognition software, such as DRAGON™, is widely used to enable users to interact with university systems and also acts as assistive software. However, less attention is devoted to voice recognition functionality than screen reading features in the WCAG 2.0 Guidelines and Section 508 standard [17]. Therefore, a complement category in our evaluation questionnaire is ‘assistive software issues’.

Our subjective evaluation method is carried out with a questionnaire survey that contains statements on the following categories: general system interaction, assistive software issues, media file issues and document file issues.

3.4 Mapping the Relationship between Accessibility and Usability

WCAG 2.0 is the main set of guidelines that will be used in our evaluation method. The four principles advocated in WCAG 2.0 are understandability, operability, perceivability and robustness (Figure 3). These four principles can be used as a core

accessibility issues classification method to map the relationship between usability and accessibility statements to finally design accessible usable statements.

In this research, we consider usability a component of accessibility. All the survey statements will be designed with this consideration in mind. Identifying the possible relationships among Section 508, SUMI and IBM and the combinations that produce accessible and usable statements creates a balance among the voices from the technical, stakeholder and experimental domains. Involving students with disabilities in the evaluation presents potential benefits, and the aforementioned balance is a significant requirement in effectively and efficiently applying the UCD method put forward in our proposed model.

Figure 3. WCAG 2.0 principles as a bridge to creating possible relationships among Section 508, SUMI and IBM

Figure 4. The proposed subjective evaluation model

The evaluation process indicated in the proposed subjective evaluation method is divided into five phases (Figure 4). The preparatory phase consists of three parts, which, if effectively determined, will favourably affect the quality of the final results. In our model, these tasks are designed to evaluate university web-based systems, but they can also be used to assess other websites (e.g. banking), which is a justification for features such as the type of web content, main goals and participants’ characteristics. In our method, the evaluation’s main goal is to evaluate university websites from the perspective of end-users to prioritize the checkpoints to be used objectively, rate their satisfaction using a Likert scale (agree, neutral and disagree) and find the most effective checkpoints in their study/work. Visually impaired and deaf users, including those with deaf-blindness, are the targeted participants in our study. University website features are designed to deliver learning and general materials, such as videos, PDF files, text and images. These files are uploaded to different types of web pages, such as home, course content, administration and news, and play important roles in university systems. Also, visually impaired individuals usually use screen reader and voice recognition software to interact with websites. All of these reasons led to classifying the statements into general, media, document and assistive software categories in the second-phase classification. The third phase is accessibility. We assign accessibility guidelines that suit each category. A human expert is

involved to cover any criteria that are missed in common guidelines. The fourth phase is analysed utilising usability criteria from standards that align with the previous phases. The final stage is mapping the relationship between the usability statements and accessibility statements to write up the final survey questionnaire statements. In the following section, the subjective evaluation based on survey results is covered.

4. THE EARLY STAGE RESULTS

Subjective evaluations commenced in August 2016 using the usability-accessibility evaluation model described above. The online survey was completed in October 2016 by 67 volunteer participants in Australia made up of visually impaired and deaf students and their assistants. The survey contained 66 multiple choice questions and 2 open-ended questions. The volunteers evaluated their university's educational web-based systems. Firstly, they started with demographic data questions. Next, they rated their agreement with statements pertaining to usability and accessibility relating to the general website, media files and document files interaction by choosing one answer from a 4-point Likert scale (agree, neutral, disagree, and unable to evaluate). Thirdly, if they were a screen reader or voice recognition user, they also rated their agreement with statements relating to these software items. Finally, two optional open-ended questions were included to capture particular issues not considered in the survey design.

The 'general issues' responses illustrated that 55% believe that the level of accessibility of their current website negatively affects their study. In the 'evaluating media contents' part, 59% agreed that most of the non-textual elements on the website pages do not have descriptive text. Half of the participants disagreed that most audio or video files have captions, subtitles or sign language, and 20% responded neutrally, and 20% agreed. Also, 40% of participants agreed that most captions, subtitles or sign language are inaccurate. The 'evaluation of document files issues' showed that 58% agreed the navigation aids, such as bookmarks headings and tables of content, are not available in most PDF files. In addition, 41% participants said the captions for inserted audio or video files in document files are not included. In respect to assistive software issues, 78% believe their website does not consider screen reader issues. For screen reader users, 69% said they cannot understand bulleted lists on their educational website pages, and 70% believed the web pages are not well structured for navigation purposes. For voice recognition users, 54% indicated that they cannot interact effectively with controls by using direct voice commands, and 54% indicated that the website does not provide instructions and advice for users about all keyboard commands.

5. FUTURE WORK

All data collected using the subjective evaluation method will be analysed using the SPSS tool to identify the correlation between variations in the accessibility of learning materials and web page content found in university websites.

Moreover, the subjective evaluations will be combined with objective evaluation methods to improve reliability through triangulation. In addition, the outcomes of the accessibility evaluation can be used as a basis in designing a set of accessibility guidelines for educational systems and in creating a foundation for developing an adaptive and accessible quality content framework for such systems to increase educator, student and developer awareness of accessibility issues.

Finally, our research project refines a methodology (outlined and piloted here) that universities can use to combine subjective and objective evaluations to create site-specific adjustments to accessibility for deaf, blind and deaf-blind students (users).

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