Web Content Accessibility for People with Cognitive Disabilities

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Abstract - Web accessibility is considered as a component of universal design, the purpose of which is to lower the discrimination level in access to the living environment for people with special needs. People with cognitive disabilities are impaired in the act of processing information such as well as remembering or reasoning, making it more difficult for them to process information in a recognized, meaningful way. This paper gives an overview of the ways of inclusion of people with cognitive disabilities in the world wide web with systematic approach regarding all aspects of design and publishing of web content. The WCAG 2.0 standards with success criteria from Level AA and Level AAA are explored in order to enable access to information and knowledge trough Internet for people with cognitive disabilities.

Keywords: web content, e-learning content, cognitive disabilities, web accessibly

I. INTRODUCTION

One responsibility of every society is to create an environment that providesequal access to all aspects of life for everyone, including formal and informal education. The ambition to fully include people with disabilities in the society is manifested in the UN-declaration of human rights and in the international and national legislations[1].Full and equal access to the Internet's World Wide Webis an enabler of other basic human and civil rights [20]).

Recently, the old-fashioned education process and process of gaining information and knowledge has been abandoned. The evolution of technology played a key role in this development. Nowadays the education is easier and the same applies to providing individualized information anytime, anywhere and on any device [9-10].

More specifically, web and e-Learning platforms thoroughly have changed the process of gaining information, knowledge and the learning process. The innovative implementations of e-Learning enable students to have access to exercises and can elaborate their assignments online[11]; to learn trough game and with the use of smart devices; to gain more motivation in the learning process and to show more interest in learning [12-14]; to acquire knowledge outside the classroom with the help of portable mobile devices [15].All these activities can be hosted, integrated and provided through Learning Management Systems[8]. But, people with disabilities don't have the same fundamental rights to access information, knowledge and services, including the Internet, as others in the society.People with disabilities are faced with many challenges when using the Internet. Therefore, the access barriers to learning opportunities reinforce the social exclusion of persons with disabilities.

As the web becomes a worldwide standard for communication, learning, entertainment, and exchange of any information, the primary work was focused on the introduction of web accessibility standards for the disabled population.

Nowadays, a respectable progress in public awareness for accessibility on all levels has been achieved. Lots of countries accept the requirements of Online and Communications Council (OCC), all government websites are confirmedby the World Wide Web Consortium (W3C) Web Content Accessibility Guidelines (WCAG 2.0). The W3C Web defines (conceives) web content as ''information and sensory experience to be communicated to the user by means of a user agent (e.g., a browser), including code or markup that defines the content's structure, presentation, and interactions'' (W3C, 2005). WCAG 2.0 is the world standard for creating accessible web contents. It is classified as the ISO/IEC 40500 standard and contains three implementation levels, 'A', 'AA' and 'AAA'.

This paper gives an overview of the ways of inclusion of people with cognitive disabilities in the world wide web.The rest of paper is organized as follows. The second section depicts the different types of disabilities with an emphasis on the cognitivedisabilities. In Section 3, we describe the impact of IT applications on accessibility of information and knowledge for people with cognitive impartments. The impact of web accessibility and how WCAG standards are suitable for people with cognitive impartment are tabled in the consequent section. The last section provides concluding remarks about full and equal access to the Internet's World Wide Web for people with cognitive disability.

II. COGNITIVE DISABILITIES

According to the Disability Services Act (1993), a disability is any continuing condition that restricts everyday activities [2]. The World Health Assembly (WHA) on May 22nd, 2001, approved the International Classification of Functioning, Disability and Health (ICF) which breaks down disability into a number of broad sub-categories, including the following 8 main types of disability: Mobility and physical impairments, Spinal cord disability, Head injuries(TBI)-Brain disability, Vision disability, Hearing disability, Cognitive or Learning disabilities, Psychological disorders and Invisible disabilities. Many people with disabilities have a combination of these impairments. The most common type is physical disability, generally relating to disorders of the musculoskeletal, circulatory, respiratory and nervous systems. Another type of disability is sensory disability which involves impairments in hearing and vision. Neurological and cognitive disabilities include acquired disabilities such as multiple sclerosis or traumatic brain injury. Intellectual disabilities include intellectual and developmental disabilities which relate to difficulties with thought processes, learning, communicating, remembering information and using it appropriately, making judgments and problem solving. Psychiatric disorders resulting in disabilities may include anxiety disorders, phobias or depression. [2]

Cognitive disabilities affect the act of processing information such as well as remembering or reasoning, making it more difficult to process information in a recognized, meaningful way for the individual [16]. Cognitive disabilities include all conditions or impairments that inhibit a person's mental process[17]. According to the Siteimprove team, cognitive disabilities may be classified in two ways, functional (includes: memory, attention, math comprehension, verbal comprehension, visual comprehension, problem solving) and clinical (includes: autism, traumatic brain injury, dementia, developmental disability, dyslexia, dyscalculia and learning disabilities in genera). In this paper we will be focusing on cognitive disorders from a functional standpoint. More specifically, we will focus on the barriers, and not on the diagnosis,of improving the user's experience.

Recently, there has been a lot of discussions about the diseases of the modern age, which are not classical disabilities such as visual, hearing or motor impairments.The cognitive disabilities are increasingly prevalent especially among children and young people. For example,theUS National Survey of Children's Health (NSCH) highlightedthe increasing trendon the prevalence of diagnosed of autism spectrum disorder (ASD) in the United States and globally within the last 30 to 40 years.

A conducted survey shows that in 2014 an average of 1 in every 59 (1.7%) 8-year-old children were identified as having ASD [3]; in the year 2018an average of 1 in every 40 children had a diagnosis of autism spectrum disorder[4].Also, the University of Michigan has estimated that between 5-10% of the population has dyslexia, but this percentagecan also be even higher than17%. The symptoms of dyslexia range from mild to severe.

The diversity of abilities and experiences of users with cognitive disabilities can indicate to problems [19]. The wide range of cognitive disabilities and their effects on users, make an already complex issue even worse. So, finding a prescriptive solution for cognitive accessibility seems almost impossible – there is no rubric that covers even the basics [18]. However, many experts offer suggestions for making websites easier to use for users with cognitive disabilities. Many of these experts' recommendations are basic usability principles.

III. ACCOMMODATING COGNITIVE DISABILITIES WITH IT

Some people with disabilitiesuse assistive technologies (AT) such as screen magnifiers,text-to-speech, keyboards instead of mice or any another assistive device for web surfing, to help them access information. Computer code allows AT software to convert content to speech for screen reading functions and audio information to text for captioning. People with cognitive disabilities benefit from these same mechanical and verbatim translations. They profit from conversions that format text to audio and the reverse, as well as from the opportunity to use content presented in multiple communication modalities and to alter the viewing format of the information presented[21].

Children and students with ASDuse augmented reality systems for improvingtheirsocial skills.This technology offers additional visualization for learning or playing, combines virtual objects generated by a computer, with a real environment [22]. The promising advanced technologies - 3D holograms can also help children with ASD for academic learning [23].

The learning management systems, such as ones compatible with life-long training and ones allowing people to gain new skills and knowledge, provide great opportunities for creating learning environments for people with disabilities, notably those with cognitive impairments and limited learning activities. These systems offer the flexibility so that the people with disabilities can adapt their training program to meet their specific needs. Choosing the most suitable LMS for people with cognitive disability is very important. Over the past few years, commercial LMS vendors, and open-source communities have invested significant resources into making their products more accessible. At the same time, accessibility still remains a challenge for users with disabilities as well as elderly people.[5]

The comparative analysis made about different levels of compliance according to the Guidelines for WCAG 2.0 standards shows ATutor as an e-learning platform outperforms other platforms that are considered in the analysis. ATutor have better features compared with the others LMSs in part of: User Interface takes into consideration navigation and forms; Personalization and Customization; Common Modules/ Tools - Accessibility feature; Authoring Tools/ Content Creation and Help and Documentation [6]

For contents on many websites and applications, today it is an imperative tobe compliant with the WCAG 2.0 standard.Listed in the implementation Level AAA are the success criteria that are arguably the most significant for cognitive-specific support mechanisms.

Dr Scott Hollier [16] has emphasizes that in relation to cognitive disabilities specifically, the WCAG 2.0 standard includes some requirements such as: providing captions in online video which provides both audio and visual reinforcement of spoken dialogue; creating content that can be presented in different ways; giving users enough time to read and use the content; making text readable and understandable, ensuring that the language of a page is clearly defined and easy to read; helping users avoid and correct mistakes, especially around inputting information into forms and clear guidance on how to fix mistakes etc.The application of these criteria makes web content more appropriate for people with cognitive impairments.

IV. COGNITIVE DISABILITIES AND WEB ACCESSIBILITY

An accessibility encompasses all disabilities that affect access to the Web, including visual, auditory, physical, speech, cognitive, and neurological disabilities. (W3C).

People with disabilities are faced with many challenges when access to information and knowledge trough Interne. The way that can facilitate this activityis the dedication to web accessibility in the web design process and/or in the e-learning content design process.When we are talkingabout web site accessibility or e-learning content accessibility it means that people with all disabilities (visual, auditory, physical, speech, cognitive, and neurological disabilities) can access information and knowledge throughthe Internet.

According to Kelly et al. [25] the Web Accessibility Initiative (WAI) has made a significant contribution on raising awareness of the issues of web accessibility, but these guidelines are incompatible for more specific e-learning contents.The author emphasizes that these incompatibilities will be overcome bya wider perspective of accessibility guidelines when it comes to the domain of e-learning.

Creating accessible web sites and applications is more time demanding. It requires technical expertise in web design or e-learning content design and also expertise in accessibility issues. By using the latest web technologies, it is easier to make accessible sites.

However, accessible web sitesbenefit everyone, not just those with disabilities. On an accessible website, the user is put in the centre of the experience. The design is clean and simple. Text is easy-to-access, more readable, more user-friendly, contentsare better organized, optimized for display on different type of device, optimized for search and easier to maintain. [7]

Therefore, the effort is to create universally accessible pages, not alternative accessible versionssuch as: text be heard instead of seen, audio be read instead of heard, images are described instead of seen, and so on.

In the created web and application contentsfor people with cognitive disabilities, the following WCAG 2.0 success criteria from Level AA and from Level AAA should be implemented: all live video content should have captions; visual content should also be represented in words; the user should be allowed to take extra time to complete a task if required; if content is flashing, moving or refreshing the user should be able to pause, stop or hide that content; there should be a clear description of the title of a web page or app screen; links should be descriptive and meaningful, avoiding phrases like ‘click here’ or ‘read more’; providing more than one way for people to find content; the language should be clearly defined so that speech recognition software interprets the page correctly; if the language changes, that change should be clearly indicated; words that are not common or considered jargon should be specifically defined such as in a glossary; abbreviations should be clearly defined.Moreoverinformation should be readable at a lower secondary level (this could potentially include a specific sheet written in Easy English); the correct pronunciation should be indicated for difficult words; nothing unexpected should happen when an element receives focus; users should be able to select an option and then confirm that option rather than immediately taking them to their choice; the navigation of the website should be predictable and consistent; language should be used consistently, e.g. not interchanging a full name with an acronym. Additionally, the user should know that an error has occurred; it should be clear what you want the user to enter; guidance should be provided to the user as to how they can fix their error; guidance should be provided on what type of information needs to be entered in the form.

The demands of web accessibility and usability for most people aresimilar. Web accessibility is considered as a component of universal design, the purpose of which is to lower the discrimination

level in access to the living environment for people with special needs [23]. Usability of web technologies is the availability of effective design of websites and applications [24]. In the paper, we summarize different guidelines and propose fourdesign considerations main areas of the specifics, which should be taken into account whencreating a web content, which be used also by the users with cognitive, learning and neurological impairment, as shown on Fig.1.

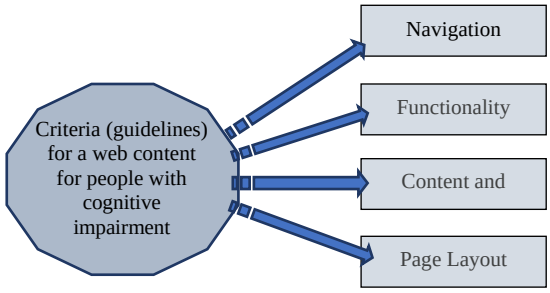

Figure 1.The main guidelines area for a web content for people with cognitive impairment

A. *Navigation*

Creating a user-friendly navigation should be one of the most important things that a professional needs to take into consideration.For people with cognitive disabilities it is of the utmost importancethat the navigation is standardized and unambiguous;headings, subheadings, and lists for structuring the informationare used; the outline of the context is highlighted;menus are short and easy to understand; limited number of options are used to prevent cognitive overload. Also, for people who use the assistive technologies it is very important that the navigation has various options[26].

B. *Functionality*

The best advice to help users with cognitive disabilities is to provide information in multiple formats, with emphasis on visual formats. Supplemental media such as illustrations, icons, video and audio have the potential to greatly enhance the accessibility of web content for people with cognitive disabilities. But, to be avoid background noises or images that distract and to be avoid advertisement and sponsored links that can defocus attention of user[26].

Options such as: font change and font size; line height change or space between lines of text; increase of the size of "clickable" areas; mouse over highlighting of text for easier reading; change of background color of a page; and color invert and contrast increase of the page will increase web functionality[18].

For this area is important to take into consideration the list of design rules that can be easily turned into general "good design principles" such as: functionalities that are as predictable as possible; providing guidance and help; avoiding complex interactive processes, keeping them simple and brief; the separate task broken up into separate pages; the steps named; remainders used; error messages explained as much as possible; user actions managed (warning when action is with serious consequences, input mask, possible / impossible actions etc.)

C. *Content and Text*

Short, simple, unambiguous phrases are easier to understand than long, complex, ambiguous ones [26]. Prioritizing information to ensure that all critical material is at the top half of the page, using a lot of white space on the page and offering text with different lands [18].Avoiding using only one method for present the content. No one method is sufficient by itself. The visual communication methods: image-only representation for the message, or relying completely on graphics, illustrations, and other non-text materials, may not be appropriate for some users. Visual communication methods include colour, relationships, styles, design elements, photos, images, etc. [26].

Avoiding non-literal content such as sarcasm, parody, and metaphors.Also, avoiding a lot of math computation and formulas. Instead of that, explaining math conceptual or performing computation automatically if it is necessaryis better[26].

D. *Page Layout*

The layout covers the availability of screen elements,form or announcement.Being consistent with pages, fonts, colors, and locations of page elements as well as providing logical reading order-material is well organized on the webpage, are one of the main principles of inclusion in web accessibility [17]. Streamline page design is very important. It is necessary to use high contrast between text and background Some time making a page visually interesting it can make a page extremely difficult to read, (graphical spacers and tables can disrupt the reading).For people with cognitive disabilities is not appropriate text that moves or changes when the mouse moves over it and also is recommended reducing clutter and extra material [18].

V. CONCLUSION

One of the general principles that underlie the Convention on the Rights of Persons with Disabilities isproviding access to all aspects for all people on an equal basis**.** It means "universal design", design usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

Taking into consideration the trend of increasing rate of people with cognitive disabilities it is necessarymore proactive role of the community to facilitate the accessibility of digital assets and web contents. Our research highlighted that implementation of WCAG 2.0 success criteria from Level AA and from Level AAA in the process of

web sites and applications design in the four design considerations main areas: navigation, functionality, content and text and page layout, will increase the web sites accessibilities.

The e-learning and e-health systems have provided a wide range of contents for people with different preferences as well as with different disabilities, so these criteria can meet their needs.A number of automatic validation tools can provide partial accessibility validation. A list of such tools is referenced on the W3C website.

As further work, we will be focusing on implementation of principles in developed e-learning platform as a part of EU and North Macedonia within the IPA project CROSS4ALL (Cross-border initiative for integrated health and social services promoting safe ageing, early prevention and independent living for all), IPA 2 – 2014-2020 (Cross4all-CN1-S01.2-SC015).

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