

# How does Web Accessibility affect the User Experience of Users with Disabilities?

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## **ABSTRACT**

There are multiple goals for this research: to raise awareness of the disabilities field and the laws that come with it, to describe the current problems in the world because of web accessibility, to increase the knowledge of web accessibility with the current guidelines: WCAG 2.0. The main goal of the research is to propose a test questioning how changing the level of web accessibility will affect the user experience (UX), specifically, the UX of users with visual impairments.

Keywords: ADA, web accessibility, technology accessibility, user experience, WCAG 2.0

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## CHAPTER 1

### INTRODUCTION

#### **Americans with Disabilities Act**

In 1990, the Americans with Disabilities Act (ADA) was passed to stop discrimination of disabilities in areas of employment, public accommodations, public services, transportation and telecommunications (Schiff). Before this act, many public places and opportunities weren't accessible for those with disabilities. Buildings and public facilities such as shopping centers, libraries, parking lots, airports, and parks were not accessible. Mass transportation such as buses, trains, airplanes, taxis and other public transportation systems were not accessible. Telecommunications services such as phone services for those with speech or hearing impairments, or closed captioning for federally funded announcements were not accessible. Before the ADA, these places and services were not required to be accessible to US citizens with disabilities, therefore, they were not able to fully participate in public activities. Before the ADA wheelchair users couldn't access public buildings that did not have ramps. Now after the ADA ramped entrances into buildings have "become the rule rather than the exception," (Jr. Robert). Under Title III of the ADA the law states "[n]o individual shall be discriminated against on the basis of disability in the full and equal enjoyment of the goods, services, facilities, privileges, advantages, or accommodations of any place of public accommodation" (Schiff). This law means that all public places, services, and public accommodations need to be accessible to anyone regardless of disability. The ADA further describes what a public accommodation is, and provides a list of twelve categories in which a public accommodation can fall under. The

ADA is essential in allowing those with disabilities equal opportunity, but since its release in 1990 there have been issues surrounding the internet, the disabled communities and the laws, specifically whether or not a website is considered a public accommodation and therefore be accessible.

The ADA was passed in the '90s before the growth and popularity of the internet. Therefore, the ADA did not set rules or regulations referring to the internet. Once the internet became popular, a few regulations about web accessibility were made through updating the Rehabilitation Act of 1973. The Rehabilitation Act is not the same as the American with Disabilities Act. The Rehabilitation Act prohibits the government and federally funded programs from discriminating against handicapped citizens. The Rehabilitation Act was updated with Section 508 which mandates that Federal agencies have their electronic and information technology accessible to everyone (GSA). It is required for all government or federal websites and all their respective technologies be accessible, however, there are no rules or regulations for public websites in either the Rehabilitation Act or American with Disabilities Act. Although, "the U.S. Department of Justice has announced plans (to be expected in 2018) to implement ADA regulations," for the internet (Deflorian). Nothing has happened in the year thus far. Many of today's websites, mobile applications, and relative technologies are not accessible, because there were never any laws mandating that these technologies need to be accessible. In recent years there have been many lawsuits surrounding this topic of web and mobile accessibility, all with differing results. The following sections will describe these lawsuits, and how the courts have come up with mixed outcomes. A look into these lawsuits will question why the ADA has yet to include regulations for today's internet technologies. Further research on web

accessibility will be explained in depth within the Literature Review. This is important because it sets up all the information needed for the Methods section, which will test the user experience of a visually impaired participant based on levels of web accessibility.

## **Legal Issues**

*In Disability Rights in the Age of Uber: Applying the Americans with Disabilities Act of 1990 to Transportation Network Companies*, Rachael Reed goes over the multiple lawsuits Uber has against them. Uber has a newer business model which features ride share technology and allow users to get rides for a much cheaper price than most taxis. Traditional taxi services were made accessible by the ADA. Individual plaintiffs and accessibility groups have sued Uber for multiple actions of discriminating against the disabled. Uber claims they do not fall under the ADA's Title III as a public accommodation, because Uber is a "technology company" not a "transportation company," they shouldn't be held to the same standard as a Taxi company (Reed). The courts have yet resolve the issue.

*In Equal Access in Cyberspace: On Bridging the Digital Divide in Public Accommodations Coverage through Amendment to the Americans with Disabilities Act*, Laura Wolk goes over discrepancies with laws and lawsuits around accessibility and whether websites should be considered public accommodations (Wolk). A few cases established that a commercial website which had a physical location or store attached to it needed to be accessible because the website would be considered a service provided from its physical location or store, and therefore fall within public accommodation. This type of thinking may not branch from all court

cases/judiciaries, and this is significant because the interpretation of the ADA Title III public accommodation varies from court to court.

Carly Schiff proposes in *Cracking the Code: Implementing Internet Accessibility through the Americans with Disabilities Act* a content analysis test which can help courts come to an agreement about cases involving the internet and other modern technologies. This test “should allow for uniform decisions and avoid inconsistent results,” (Schiff). Schiff breaks down multiple lawsuits and describes inconsistency between each. For example, in the case *Access Now v. Southwest Airlines* there was a virtual ticket counter that was supposed to be convenient for Southwest.com users. A blind individual argued that the virtual ticket counter was inaccessible. The court decided that the virtual ticket counter was not a place of public accommodation under ADA Title III, because there was no connection between the website and a ticket counters geological location. In the case *National Federation of the Blind v. Target Corp*, a blind individual argues that Targets website was inaccessible. The court found a portion of the website to be a public accommodation under ADA Title III because of its attachment to a physical location, but found the other services attached to Target.com not be a public accommodation (Schiff).

Clearly, accessibility within websites and other mobile technologies are causing an uproar within the disabilities and civil rights fields. Outcomes of mixed rulings among courts have been causing problems. If websites were considered a place of public accommodation in the ADA many of these lawsuits could be resolved. The ADA hasn't been amended for web accessibility yet, one day the ADA will. Even though the law doesn't require the web to be accessible, web accessibility is still very important for the inclusion of everyone regardless of

disabilities. This research is a step in pushing towards the making web accessibility public knowledge, and something that shouldn't be required by law, but necessary by humankind.

### **Significance of Research**

A significant percentage of the population is being left out when certain websites and technologies aren't accessible. "Nearly 20 percent of the population in the United States has [some sort of] disability" (Espino). If designers had more knowledge of the ADA and current issues within the disability civil right acts, many technologies would be able to expand and reach more of the population. This study could influence art schools/universities to add design for accessibility or inclusion within their curriculum. It could also expand other technologies and other fields, like social media, etc. This study could impact more designers or creative thinkers to create more accessible technologies. For example, think about the untapped market for creating mobile games for those who are blind. The study *Turn Off the Graphics: Designing Non-Visual Interfaces for Mobile Phone Games* takes an in-depth approach and explores the idea of non-visual games for more accessibility with blind users (Luis). This way of thinking could allow designers to create a brand-new genre of mobile gaming and on top of that it could be life changing to those who've never been able to fully participate in mobile gaming before. If designers knew about accessibility or any other issues within the disabilities field maybe it could inspire them to create more types of accessible mobile games, websites, etc.

There are multiple goals for this research: to raise awareness of the disabilities field and current accessibility issues with today's internet technologies, to increase the knowledge of web accessibility with the current guidelines: WCAG 2.0, and lastly, to test how altering web

accessibility will affect the users experience of users with disabilities, specifically, users with visual impairments.

## CHAPTER 2

### LITERATURE REVIEW

#### What is Web Accessibility?

The World Wide Web was created by Sir Tim Berners-Lee in 1989. In 1990, one year after the birth of the internet, the Americans with Disabilities Act (ADA) was passed (Schiff). The ADA did not include internet technologies to be accessible, because the internet then was not nearly as popular as it is today. The growth in popularity of the internet and the fact the internet was not required to be accessible left many users behind. Approximately eight years later, the main international organization that produces web standards, the World Wide Web Consortium (W3C), launched the Web Accessibility Initiative (WAI) (Feingold). WAI is an important movement and an effort towards improving web accessibility. The W3C also is responsible for developing the Web Content Accessibility Guidelines (WCAG). The WCAG are a set of guidelines that outlines what developers can do to make websites and mobile applications accessible to certain degrees. The most current set of guidelines are the WCAG 2.0.



*Figure 1 W3C Logo (W3C).*

Many legal issues have surrounded the topic of web accessibility. Only a few industries have been mandated by law to have their online presence be accessible. For example, government official websites. “Dozens of high-profile brands and institutions have been hit with

sizable lawsuits in recent years, including Fordham University, Foot Locker, Brooks Brothers and more,” (Deflorian). These and many other lawsuits have shifted many companies views on making their technologies, mobile apps and websites accessible.

Web accessibility is important to the User Experience (UX) because without it there would be no experience, or at least the experience would be terrible. For example, there is a web user who is deaf, he’s trying to watch a video. Sadly, the video contains no closed captions, no transcripts, or anything, the user is left with only being able to see the video. Since he is deaf, without captions or transcripts to read this information is inaccessible to him. How does an instance like this affect his UX? His UX is probably quite terrible, he can’t interact with the video information, and he leaves feeling bad about the website interaction and its brand.

### *Assistive Technology*

Assistive technologies are hardware and software that help those with disabilities. Assistive technologies allow many people with disabilities to access information on the web, and independently navigate through the web. For example, a screen reader can read written text from a website aloud so a user who many not have sight can hear what is written on the screen. Assistive technologies can also magnify the screen to make graphics and font sizes larger, create braille outputs, provide shortcuts for navigation, and even have voice recognition software to scan, switch, type and command.



*Figure 2 Examples of Assistive Technologies (Sulopa).*

Assistive technologies are extremely helpful, “however, many web technologies are not designed in a manner that is compatible with assistive technology or are otherwise inaccessible to individuals with disabilities,” (Briggs). If assistive technologies can’t completely access the web, this may prevent possible educational or professional opportunities. It could also prevent social activities and inclusion. How would the user feel about those missed professional opportunities or those missed possibilities for social inclusion?

### *Accessibility Implementation*

The Department of Justice (DOJ) have already enforced action to websites that lacked accessibility. However, the DOJ has ignored mandating the laws to require websites be accessible. The DOJ has only enforced actions upon companies and institutions that were sentenced in lawsuits about accessibility. The DOJ recommended following the WCAG 2.0 guidelines with a minimum level of AA “as a baseline for compliance with the statute in enforcement actions,” (Espino).

WCAG 2.0 Level	Live Content		Pre-Recorded Audio/Video Content					
	Captions (audio/video)	Captions (audio only content)	Captions	Transcript (audio-only content)	Media Alternative Transcript	Audio Description	Extended Audio Description	Sign Language Interpretation
A			✓	✓	✓ (or Audio Description)			
AA	✓		✓	✓		✓		
AAA	✓	✓	✓	✓	✓	✓	✓	✓

*Table 1 Example of what defines the WCAG 2.0 levels for Live Content, and Pre-Recorded Audio/Video Content (Ai-Media).*

Implementing accessibility into an already built website can face challenges. It is easier to plan out accessibility from the start of the websites development. Even though it isn't required that all industries have accessible websites by law, it would be smart to use WCAG 2.0 minimum level AA when developing a website before lawsuits take place or the law changes to mandate web accessibility. In the Methods section, four websites with the same website content will be tested. Website 1 will fulfill WCAG 2.0 level A. Website 2 will fulfill WCAG 2.0 level AA standards. Website 3 will fulfill WCAG 2.0 level AAA standards. And Website 4 will not purposely fulfill any type of accessibility standards. This test will examine how different levels of accessibility can change the user experience of a user with disabilities.

## **Few examples of web accessibility**

### *Alternative Text for Images*

Within HTML code, which is the code to build websites, it is important that images include alternative text (alt text). Alt text should describe the image, if an image doesn't have alt text it is not accessible. For example, a blind person relying on assistive technology such as a screen reader to read the information on the webpage aloud would completely skip the image that doesn't have alt text. The blind user would be unaware of the images presence on that website, therefore possibly missing vital information. There are other uses for alt text, if a users' website image content cannot upload, the alt text would become available. In this instance, the alt text would show and replace the image that couldn't load. Vital information within the alt text could also be used for search engines and SEO (W3C Web Accessibility Initiative).

### *Keyboard Input*

It is important for websites to be able to be controlled from keyboard input. Website shouldn't only rely on a mouse for web access. Some people physically can't use a mouse, either due to limited fine motor control or age. Assistive technologies such as a speech-to-text input could mimic the keys from the keyboard and allow users with disabilities the access to use the keyboard via assistive technology, therefore accessing the website.

## *Transcripts for Audio*

The way in which alternative text on images are there for those who can't see, is similar to how transcripts for video or audio files are there for those who can't hear. Making transcripts accessible for people who are hard of hearing or deaf is important in allowing them access to the content. The information that appears within a transcript could also be used for search engines and SEO opportunities (W3C Web Accessibility Initiative).

These different forms of web accessibility are important to identify because within the Methods section, these forms of accessibility, alt text, keyboard input, transcripts and more, will be altered within each of the websites depending on the WCAG 2.0 level change.

## **WCAG 2.0**

This resource is a free highly technical guideline written for web developers. WCAG 2.0 provides a detailed standard for what accessibility should be for any web content (Espino). Following these guidelines should make website material accessible for those using assistive technologies. Listed there are 12 guidelines, that fall into 4 main categories: perceivable, operable, understandable, and robust. Each guideline contains a level of A, AA, and AAA, which measure the overall accessibility. Level A being the minimal amount of what is considered accessible, and level AAA doing everything it takes to make the site completely accessible. The Department of Justice required companies who have been sued due to their lacking website to follow the AA criteria or receive penalties.

### *Perceivable*

The user can perceive information from the website and use interface components with their available senses. For example, this could mean adding alt text, providing captions and transcripts for video. “Sign language could even be added for audio content,” (Espino). Developers should think about how they can present content in diverse ways, without losing the content’s meaning. Website HTML should be organized and constructed properly, so assistive technologies can read it clearly. Color should not be the only way of presenting information or establishing content. Fonts and text should resize up to 200% without losing information.

### *Operable*

The website should be able to operate by using assistive technology. The user should be able to use the keyboard to access the entire content. Either by using the Tab key to tab across the content or connecting assistive technologies to control the keyboard. For example, a program that simulates keyboard functionality through speech-to-text. The user should also be able “to pause certain sections if they need more time,” and developers should “ensure pages are clearly labeled so that users can keep track of where they are on the website,” (Deflorian). It is important to note to avoid designs and videos with unnecessary flashing lights to help epileptic users avoid seizures.

### *Understandable*

The content should be understandable, and the navigation through the pages should be understandable. Make sure all text is legible and the language is clear. Definitions for unusual

words or abbreviations should be provided. The navigation should always appear in the same place for each page. Error messages should always suggest to the viewer how to correct the error. Users should also be able to review, correct or reverse submissions (Espino).

### *Robust*

Content should be robust and should be able to be accessed by a wide variety of differing assistive technologies. “Developers should maximize compatibility with current and future user tools by ensuring that page mark-ups can be reliably interpreted by assistive technologies and by providing name, role, and value for nonstandard page features,” (Espino).

It’s important to explain the WCAG 2.0’s main categories, and the levels of accessibility, because this will be the measure for making the 4 different websites with the same content. Following these guidelines will standardize the website’s accessibility with its level being the only thing that differs: no grade, A, AA, or AAA. How will the same website change when its levels of accessibility change? Will the changes be visible, if any?

In *Implementing Recommendations from Web Accessibility Guidelines: A Comparative Study of Nondisabled Users and Users with Visual Impairments*, Sven Schmutz compares the effects of WCAG 2.0 accessibility levels for both nondisabled users and users with visual impairments. Schmutz points out that most of the time the WCAG 2.0 is labeled as a tool to make web content accessible for only those with disabilities. The results show opposite; the WCAG 2.0 support users with and without visual impairments the same and makes web content both accessible and user friendly for all. Schmutz’s study is important because it aims to understand possible advantages and disadvantages the WCAG 2.0 may have when it comes to

different types of users. This research opens the question of whether or not different grades of accessibility outlined in the WCAG 2.0 will have any effect on a user's experience.

### What is User Experience?

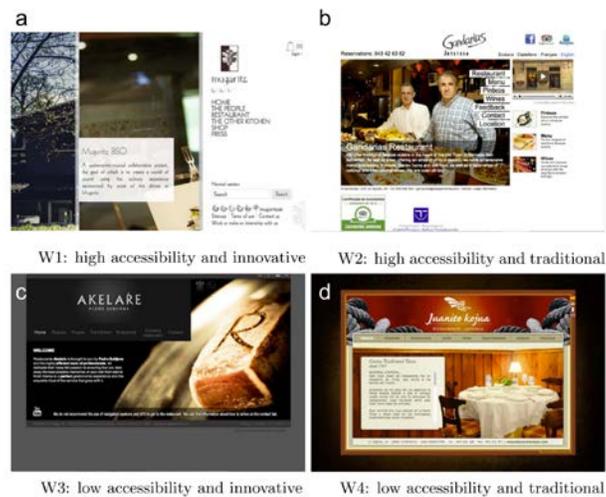
User Experience (UX) is how a user feels from using a product, system or service (UserTesting). There are many aspects to UX. Peter Morville breaks down the user experience with his UX honeycomb: useful, usable, desirable, findable, accessible, credible, and valuable.



*Figure 3 Peter Morville's UX honeycomb (UserTesting).*

Each aspect is important in building the overall user experience. Useful: the product or service is useful to the user. Usable: the user can use the content. Desirable: the user's emotions are evoked by the design. Findable: the user can find what they need, or the content can be navigated easily. Accessible: everyone can access the content regardless of disability. Credible: the user believes and trusts in the content. Valuable: the product or service has added value in the user's life. It is important to note these aspects of UX because these aspects will be examined by the examiner during the Usability Test within the Methods section.

In *Exploring the Relationship Between Web Accessibility and User Experience*, the researcher, Amaia Aizpurua, focuses on exploring connections between the UX and web accessibility. For this research, Aizpurua analyzes two different types of web accessibility: the users perceived web accessibility and the guidelines outlined in the WCAG 2.0. Aizpurua tested a user's experience using four different restaurant websites, shown in figure 4.



*Figure 4 The four restaurant websites tested. Each website has a different standard of web accessibility: low or high. Each website has different UX stimulation attribute: traditional or innovative. (Aizpurua).*

For Aizpurua's study, all the participants were visually impaired and used assistive technologies, such as screen readers. The participants were asked to complete an interview about themselves for demographics, then they were asked to complete certain navigation tasks on the given website. Lastly, the participants were asked to complete an interview and questionnaire about their experience with the website. The results of Aizpurua's study revealed that most UX attributes are significantly correlated with perceived web accessibility because UX attributes

(examples such as interested, disappointed, or annoyed) are more familiar terms to the participant than the technical terms that are found in WCAG 2.0. Aizpurua's experimental approach and techniques are important to note because certain aspects from Aizpurua's approach will be reformed in the Methods section for this research proposal.

In the Methods section, the UX of users with disabilities will be researched and collected. This study will test how altering web accessibility will affect the UX of users with visual impairments. The same content will be presented in four different websites. Each website will have a certain grade of accessibility: none, A, AA, or AAA. Overall, this research questions how various levels of web accessibility will change the user experience of a user with disabilities.

## CHAPTER 3

### METHODS

The following sections will contain information on how the usability testing and survey analysis to investigate user experience will be conducted.

#### **Usability Testing**

This test will be maintained and supervised by the examiners. The focus of this test will be collecting research on how the User Experience (UX) of users with disabilities change depending on the accessibility levels of a website. This research is important because web accessibility is not mandatory through laws such as the ADA yet. It also emphasizes how important web accessibility is to users with disabilities, even though web accessibility isn't required by law. Usability testing will allow designers to see their designs in action facing problems with designs and having other perspectives of the usability of their designs (NDA). This research is intended to make web accessibility "become the rule rather than the exception," (Jr. Robert).

There are four main categories of disability: visual, auditory, physical and cognitive. But there can be a great amount of variability within each category. For example, color blindness is much different from low vision or total blindness. (Deque)

The large amount of variability within each category will be taken into consideration when testing participants. For this study, we be targeting users with disabilities from the visual category, so users who are visually impaired.

## *The Test*

The same website content will be designed in four separate ways, each with different accessibility levels as outlined in WCAG 2.0 standards.

Website 1 fulfills accessibility standards: WCAG 2.0 level A

Website 2 fulfills accessibility standards: WCAG 2.0 level AA

Website 3 fulfills accessibility standards: WCAG 2.0 level AAA

Website 4 does not purposely intend fulfill any accessibility standards

Participants will navigate through all four of these websites, with given actions. An example of a given action would be “Navigate to the blog post and leave a comment,” or “Interact with the video information on the about page.”

An examiner will supervise this usability test. The examiner will record the participants use of each website per the given actions. The examiner will “focus on errors related to accessibility ... and watch for potential barriers to access rather than general usage,” (Deque). How long it takes for the participants to complete the given action will not matter. If the participants do not complete the given action this will affect the UX.

The UX will happen during the supervised usability testing. Following this usability test the participant will be asked to complete an online survey about their experiences, how they feel about the website, and its overall usability. We will let the them know that we want to hear their personal opinions about the website. The participants will be told that there are no wrong answers. The survey will give insight on how they feel about their experience with the website.

## Survey analysis

This survey is intended to collect data from the participants on how they feel towards the website right after they have completed the usability testing. The survey will include, in the form of multiple choice, a scale to measure how much the participant agrees or disagrees with the statements provided. Examples of statements include, "I am satisfied with this usability of this website." or "I would recommend this website.". The multiple-choice answers are as followed: 1 strongly agree, 2 agree, 3 neither agree nor disagree, 4 disagree, 5 strongly disagree. The last few survey questions will be open-ended. An example of this type of question would be, "What could we do to make your experience more enjoyable?".

This survey will give insight to how the user feels about the website and its overall accessibility. The survey data will take into consideration whether the participant completed the given action and be analyzed as so. The data will be collected via an accessible internet survey right after one website usability tests are performed. There are four websites, so there will be four usability tests and four surveys. If necessary, an examiner can administer the internet survey and help the participant in submitting it by, for example, reading aloud the choices, and choosing the participants answer.

The internet survey will be hosted by Survey Gizmo. We have found that Survey Gizmo easily provides web accessibility for their surveys. Survey Gizmo provides free online survey software, there is however a cap at three surveys at a time, the number of questions per survey and 100 responses total (SurveyGizmo). Survey Gizmo's unlimited survey, question, answer subscription is \$25 per month and includes other things such as, sending email invitations, and

data reports. This unlimited plan, at just \$25 a month, will allow us to make the four surveys based on the four different websites, collect an unlimited number of responses, and pre-compile the survey data. The survey analysis will conclude the UX testing.

## **Participants**

The sample population we are focusing on are web users that have disabilities in the visual category. The participants will be treated with care and respect. These surveys will be held within an accessible location, a research lab. The participants should feel safe and secure during the duration of this research. They will be asked to fill out an informed consent form. Participant personal data and information will also be kept private. When the data is published, participants real names will be replaced with fake ones for confidentiality.

There will be an incentive for participating in this research, such as a gift card or other type of reward. We want to test and survey at least 500 people. We will reach out to organizations for specific disabilities, local senior centers and university programs to collect participants (Deque). Out of this pool, we will randomly select our participants. The population should be considered stratified because we are only taking a population with certain disabilities that pertain to their sense of sight, although it may not be stratified because all people have different disabilities. We could test those who are blind, but some participants who are blind could also have another type of disability and could represent another population. We expect a margin of error +/- 4%, with a sample size of 500, assuming a 95% level of confidence. We estimate that the sample will answer conservatively and respond 50% in any given way. This testing research will take a few months to a year to complete.

For this test we are asking a participant to test usability of four websites, and then take four surveys, one for each website tested. We do not want to stress the participant with back to back website testing. We want the participant to have free time or some time to relax before conducting the next set of website test and surveys. We may also just have one user test one website a day. Again, if a participant needs help with the internet survey, an examiner can administer the internet survey and help the participant submit it. We want the participant to feel welcomed and have all the tools necessary to fully participate in the research. Assistive technologies will be provided. For the consistency of this research, it is vital that the same assistive technologies are used. If a participant uses their personal assistive technologies this could possibly skew data, because not all assistive technologies are made the same way, they also may not analyze websites in the same manner.

## CHAPTER 4

### CONCLUSION

We expect to find that increased web accessibility will lead for a better UX for participants with visual impairment disabilities, although this might not be the case at all. We might find that there is no correlation and that the UX remains the same even though the accessibility has changed. We might find that a websites functionality due to website accessibility could relate to the amount of time a visually impaired user spends on the website. This research has the possibility to find any type of connections between design, accessibility, and UX. We ensure that the results are beneficial because the result of this research matters. There is a push towards making web accessibility mandatory. The results of this research could help push towards a better tomorrow.

This research is applicable for furthering research within the disability studies field. We could expand our study one day into a different field of disability. Other future studies could replicate our methods and expand into an entirely different disability, as well. For this study, we focused on visual impairments within the disability visual category. Future studies could focus on different impairments in different disability categories such as physical, cognitive, or auditory. More research in this field will improve web accessibility and the user experience for the user with disabilities.

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