EXPLORATION OF TEXAS PUBLIC UNIVERSITY EDUCATION WEB PAGES ACCESSIBILITY

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Abstract

Background: In the past twenty years, the Internet has revolutionized daily lives by making varied types of information freely available. Because of this technological revolution, colleges and universities have been forced to rethink the information they provide on their websites for prospective and current students as well as alumni. However, many of these websites have accessibility and usability issues, especially for site visitors with disabilities. Universities that receive federal financial aid are required to make reasonable accommodations to provide accessible content on the web, and non-compliance can result in barriers for people with disabilities and in investigations by the Office of Civil Rights. **Purpose:** The purpose of this study was to explore accessibility of web pages of colleges of education and teacher education programs of public universities in the state of Texas as determined by Web Content Accessibility Guidelines (WCAG) 2.0. **Methods:** The sample consisted of 26 public universities in Texas who had a college of education and a teacher education program and whose enrollment ranked in the top 70%, based on the number of candidates who completed teacher education program requirements in 2017. During the fall of 2019, the researcher evaluated representative pages from the college of education and teacher education programs at each selected university for a total of 52 web pages. Data was collected using the automated web accessibility and readability evaluation tools SortSite and Readable. The data included WCAG 2.0 recommended accessibility guideline success criteria and reading levels for each page. Data were analyzed using SPSS to describe the web accessibility using multiple guideline variables. **Results:** The web pages of colleges of education and teacher education programs of public universities contained accessibility

errors. Guideline 2.3, designing pages in a manner that does not induce seizures, passed on all of the pages scanned. Guideline 4.1, maximizing compatibility with user agents such as assistive technology, failed the most scans (88% of the pages). Low passing scores were also present on two WCAG 2.0 guidelines, resulting in web page content that may present perception and operability barriers to learners. Paired samples *t* tests suggested that the college of education and teacher education web pages did not differ significantly in pass rates for each of the 12 WCAG 2.0 success criteria. Readability indicators, both Flesch Kincaid Grade Level and rating, showed no significant difference between teacher education pages and college of education pages. **Conclusion:** Overall, the college of education and teacher education web pages have similar accessibility levels. One guideline consistently failed, resulting in pages that are not robust, or accessible by user agents and assistive technologies. Learners using assistive technology, different browsers and mobile devices may not be able to understand, view or use the web pages. Findings from this study provide information that university personnel can use to improve the web experience for individuals that visit their sites and address web page non-compliance issues causing learning information access barriers for students.

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Introduction

In the past twenty years, the Internet has revolutionized our daily lives by making all types of information freely available at our fingertips. Because of this technological revolution, colleges and universities have been forced to rethink the information they provide on their websites for prospective and current students as well as alumni. However, many websites, such as those at community colleges, are not accessible to all learners (Erickson et al., 2013). According to McKenzie (2018), "Universities that receive federal financial aid are required by law to make reasonable accommodations to ensure their web content is accessible to everyone, including, but not limited to, people who are blind, deaf or have limited mobility" (para. 2).

Faculty and students are increasingly utilizing web-based resources during instruction at post-secondary institutions throughout the United States. University websites are accessed by site visitors to locate information before some students matriculate (Tate, 2017). The sites are a means of displaying information for potential students, informing the public of university policies, resources and events, and providing support resources for students who are currently in attendance. Student resources are provided via many mediums on the university site.

University websites throughout the United States may be comprised of thousands of pages that are developed by numerous people who have a variety of web design and development knowledge, skills and abilities. However, many of the university's pages are not accessible to students and other visitors who have different disabilities. For example,

Kimmons (2017) found that web pages at institutes of higher education are not meeting basic accessibility levels.

Problem Statement

The web-based instructional resources may consist of learning management system sites, which include externally linked pages and documents developed at the post-secondary institution to support student learning and increase their opportunities for success. Individuals with varying skill levels and knowledge related to accessible design develop the resources. However, many of the web-based resources are not accessible to learners with different types of disabilities, including intellectual disabilities. Developers sometimes have intellectual disability awareness deficits and omit the needs of some learners when building web pages (Kennedy et al., 2011). Users access through screen-reading technology often encounter access barriers, including navigation issues and lack of text alternatives for images.

Given the abundance and variety of hardware and software options available, learners with disabilities may access the resources via many different platforms. If a student is unable to access the resource due to a disability, or experience compatibility issues with access via assistive technologies, then it can become a barrier to their learning. The obstacles may be preventable if developers adhere to active and valid evaluation processes during the creation of the resource. There is a great quantity of resources developers may access to help them evaluate sites during the creation process; however, it remains that inaccessible sites and resources continue to exist and emerge.

Presently available web site accessibility resources include automated site checkers, peer review, 508 compliance checklists and end user testing. Each resource has

both benefits and challenges to its use. Additionally, the validity and reliability of results generated from each may be situationally influenced by the developer. Choosing a method that is aligned with a site's content and purpose is recommended.

Developing and implementing accessible web-based resources can be challenging for developers, although there are many evaluation techniques and resources at their disposal due to evolving accessibility standards and principles. As Chow et al. (2014) point out, user data that developers could use to improve websites, may be available and yet not incorporated in web page updates. While different techniques yield viable and usable results, it is up to the developer to determine how and when the results are utilized. Understanding the application of the results and acting on the data yielded from the evaluations can help improve the accessibility of sites.

During the design and development phase of web-based resources, developers, utilizing existing methodologies and instruments, do not always consistently, accurately and validly evaluate applications and websites for students with learning disabilities. For example, a developer creating a page customarily accessed by people with visual disabilities may omit user or screen reader testing and rely solely on automated scanning. The omission may result in an inaccessible page that passes automated scan criteria yet fails user testing.

Consequently, inaccessible web applications and sites continue to be developed and used at universities throughout the United States. Evaluation methodologies and guideline resources exist; however, barriers to their implementation are present and result in developers choosing or selecting to forego accessible design practices that would promote and increase the implementation of accessible university level websites. These

sites can then became catalysts as opposed to becoming barriers to learning. García and Diaz (2010) suggest that if the intended site visitor is unable to navigate and locate information on a website then information content access obstacles exist. The barriers generally result in site usage declining or becoming nonexistent.

Purpose

The purpose of this study is to determine the level of accessibility of public university web pages as determined by Web Content Accessibility Guidelines (WCAG) 2.0 guidelines (Accessibility Guidelines Working Group, 2008). This study aims to explore and describe the accessibility of public university college of education and teacher education program web pages in the state of Texas. Identifying the success criteria that exist or are absent from university pages may assist the evaluation processes and developer practices that influence the development of accessible websites at institutions of higher education.

Many factors may contribute to the development of inaccessible instructional web-based resources. Some of the factors include resource evaluation methods, resource availability, management support, and developer knowledge, skill, experience, and self-regulation. Identifying how accessible university pages are, as determined by WCAG 2.0 criteria and their consistency in accessibility compliance across multiple web pages, may contribute to the identification and refinement of processes that could reduce the production of inaccessible sites.

Of the many potential factors that may influence the creation of inaccessible resources, evaluation methods and techniques appear to have the greatest impact. The aspects related to the evaluation process may be unique and provide insight into the

standards and development processes of a large population of developers. They will also provide awareness of the knowledge, skills, and abilities developers should have in order to effectively develop accessible sites.

Part of the website creation process involves the evaluation of a site during various stages of development. At some point in the process, developers may not be evaluating, or incorrectly evaluating, a website. Since various tools and resources are available for use, it is possible the tools are not valid, may be used incorrectly, or are insufficient in their capacity to evaluate a site. Developers may use surveys, expert analysis, or automated programs to evaluate sites, and each has evaluation strengths and weaknesses. The findings from this study could help identify and remedy web pages during the development and evaluation phases, thereby supporting development of web-based learning applications that more accessible and usable by learners with disabilities.

Furthermore, the findings may assist instructional designers as they design training for web developers regarding instructional website development. In addition, developers working outside the realm of post-secondary institutions who are trying to improve accessible development practices and reduce inaccessible site implementations may potentially utilize information gleaned from the study. Increasing the body of knowledge around varying abilities and website access may involve significant changes to the evaluation and development process. For example, a sounder understanding of specific abilities may reveal that modifying user testing instruments will result in an increased collection of valid and reliable data when user testing occurs. Obtaining the insight of people with dementia during website creation can be useful in evaluating and establishing a more accessible site (Freeman et al., 2005).

Research Questions

This study seeks to address the following:

1. How accessible are public university college of education and teacher education program web pages in the state of Texas as determined by WCAG 2.0 guidelines?
2. How readable are public university college of education and teacher education program web pages in the state of Texas?
3. Is there a difference in accessibility and readability between web pages of Texas public university colleges of education and their teacher education programs?

Significance

The study provides multiple significant elements that college administrators and web page designers and developers may utilize in the web development process. The study may also add to existing knowledge about the relationship between readability and accessibility. Olney et al. (2017), report that most people are not reading at a nearly adequate level for success when first enrolling at a university. Additionally, identifying the success criteria that exists on university websites may assist in modifying web page evaluation processes at institutions of higher education. These changes will have an impact on learners of varying ages and those with differing abilities that access web-based resources. An increase in accessible sites and resources will potentially increase learner success across a variety of learning environments.

As current and future resources are developed, it remains that in order for them to be accessible and effective, at some or various points during the process, individuals, or groups involved in the design and development will perform an evaluation using one or more methods or tools. Changes to sites may result from the evaluations. According to a

study by Burmeister (2010), when websites undergo alterations, some populations such as the elderly, may encounter challenges as they view the site and attempt to adjust to the changes. Current evaluation processes, and perhaps changes to sites, can reveal factors that may enhance or improve current evaluation practices.

Developers employ a variety of techniques to obtain evaluation information about the websites they are developing. They may use automated tools, surveys, developer screening techniques, user testing, or data mining processes. Identifying successfully implemented techniques may lead to an evaluation approach, or combination of approaches, that result in the creation of accessible instructional web-based resources. This increases the opportunity for success of the learners who ultimately access the resource.

Approach

Given the research questions and purpose of the study, a descriptive survey research design involving collection and analysis of Texas public university colleges of education and teacher education programs web pages was conducted in Fall of 2019. The researcher evaluated 52 web pages from 26 public universities in Texas who had both a college of education and a teacher education program and whose enrollment ranked in the top 70%, based on the number of candidates who completed teacher education program requirements in 2017. Data was collected using the automated web accessibility and readability evaluation tools, SortSite and Readable. The data included WCAG 2.0 recommended accessibility guideline success criteria and reading levels of each page.

The WCAG 2.0 guideline and success criteria data provides exploratory findings about the current accessible state of the web pages and also yielded summary data to

support measures of central tendency. Readability data included the reading level of the pages scanned. Analysis of this data contributed to insight regarding the accessibility guideline about making text content readable and understandable.

The WCAG 2.0 guideline variables align with the principles that guide the creation of accessible web pages. The four principles are perceivable, operable, understandable and robust. Each principle is defined by guidelines and the success criteria that must be met to successfully achieve a passing check from the evaluation tool. After collecting the data, the researcher entered it into the Statistical Package for the Social Sciences (SPSS) for analysis.

To obtain the WCAG 2.0 guideline data, the evaluator entered the universal resource locator (URL) of each university web page scanned into the evaluation tool, selected the scan parameters, and initiated the scan. When the scan completed, the detailed results were presented, and the guideline variables were marked as either *passed* or *failed* on an Excel spreadsheet. A mark of *1* on the spreadsheet indicated the page passed the accessibility scan, and a *0* indicated the page failed the scan. The data obtained via the scans were compared across colleges of education and teacher education programs in the sample set, and themes related to key areas of web page accessibility were identified.

Summary

Colleges and universities continue to utilize websites for multiple intentions, from student recruitment to learner support during coursework. Findings from this study offers web page developers and university personnel insights that can identify focus accessibility areas in order to support improvements of the web experience for site

visitors and to address web page non-compliance issues. In the next chapter, a review of the literature provides insight into disabilities, legal compliance requirements and developing for accessibility considerations.

Chapter II

Review of Literature

The number of students with disabilities enrolling in post-secondary institutions in the United States has increased and is projected to continue on an upward trend over the next few years. According to the U.S. Department of Education (2019), "Nineteen percent of undergraduates in 2015-16 reported having a disability" (para. 1). Further, as the proportion of students with disabilities in higher education expected to increase, their dependence and use of web-based learning solutions and various assistive software and hardware options is also likely to increase.

It is imperative that all instructional web-based resources adhere to standards that address accessibility. Currently, this is not the case. Many websites, such as those at community colleges, are not accessible to all learners (Erickson et al. (2013). To develop an understanding of why instructional websites may be inaccessible, a comprehensive review of accessibility laws and policies, disabilities categories, accessibility guidelines, website evaluation techniques, website development practices, and website developers' accessibility perceptions will be described.

Accessibility Laws and Policies

Currently, millions of websites, accessed by people across the world, exist for a plethora of intents and purposes. Institutions of higher education websites in the United States are a category of sites that exist to meet the diverse needs of people who interact with universities for a multitude of reasons. Students, parents, faculty and university personnel are some of the many people who view the sites on a daily basis. In the United

States, there are laws and policies in place to ensure that people who may have a disability have the opportunity to access the pages.

Laws and policies exist at the federal, state and institution levels and are in place to ensure an accessible web presence for universities and people who access the pages. All public universities in the state of Texas are required to adhere to the federal laws, state of Texas laws and university policies. A review of the current literature relevant to each will be discussed.

Federal laws related to web accessibility include Section 508 of the Rehabilitation Act of 1973, as amended, Americans with Disabilities Act of 1990 (ADA), as amended, Section 504 of the U.S. Rehabilitation Act of 1973, as amended, and Section 255 of the Telecommunications Act of 1996 (U.S. General Services Administration, 2018). Each of the Acts may apply to more than just websites; however, each is related in some manner to web accessibility requirements of different entities in the United States. There is overlap in some of the laws, yet each applies in some manner to the requirements for providing accessible websites at public institutions of higher education in the state of Texas.

Section 508 of the Rehabilitation Act of 1973 was amended in 1998 and requires federal agencies to make their information technology accessible (U.S. General Services Administration, 2018). Section 508 requires that people with disabilities have access to information similar to any other person. Standards that must be met to comply with the Act were adopted from the World Wide Web Consortiums (W3C) Web Content Accessibility Guidelines (WCAG). Initially, the guidelines were established as WCAG

1.0. The W3C has updated the guidelines over time as web technologies have evolved; currently, the guidelines are WCAG 2.1.

Section 508, although initially intended for federal government technology, directly affects universities in Texas. Public universities in the state of Texas must follow Section 508 requirements under Title II since they receive federal funding. This has the potential to induce noncompliance since the guidelines change, and university personnel must adapt to the change and potentially update pages. However, to achieve compliance at a higher WCAG level developers usually do not need to implement major revisions to sites that met prior guideline requirements (Hilera et al., 2013). Compliance with Section 508 standards results in accessible websites (Jaeger, 2006).

The Americans with Disabilities Act of 1990 (ADA) may impact private and public universities in conjunction with Section 508. Since state universities in Texas are in the public arena, the sites and pages developed for the university must be accessible according to standards established in Section 508. Private institutions of higher education in Texas, and throughout the United States, may be more directly impacted by ADA requirements. According to information at U.S. Department of Justice (n.d.).

> Title III prohibits discrimination on the basis of disability in the activities of places of public accommodations (businesses that are generally open to the public and that fall into one of 12 categories listed in the ADA, such as restaurants, movie theaters, schools, daycare facilities, recreation facilities, and doctors' offices) and requires newly constructed or altered places of public accommodation, as well as commercial facilities (privately owned, nonresidential

> facilities such as factories, warehouses, or office buildings) to comply with the ADA Standards. (para. 1)

While it is not clearly delineated or agreed upon by private and public entities as to whether and when a private website is required to be accessible, Thomas and Bhargava (2011) asserted that private website owners may want to proactively change their web accessibility compliance tactics. Current court cases about whether or not websites are considered places of public accommodation illuminates the relationship between websites and ADA(Podlas, 2015). Maintaining accessible sites affords private entities opportunities to provide resources and information to employees who may need sites to meet certain accessibility levels of compliance.

Section 504 of the U.S. Rehabilitation Act of 1973 is applicable to institutions of higher education who receive federal funding. It is a civil rights law according to 29 U.S.C. Section 794 that prohibits excluding qualified individuals with disabilities from participating in, denying the benefits of, or being subjected to discrimination under any program or activity receiving federal assistance (Office for Civil Rights, 2017). Since public universities in the state of Texas receive federal funding for many different programs, it is required that they do not discriminate against individuals with disabilities by implementing websites that are not accessible. Additionally, private institutions of higher education in the state of Texas, if they receive federal funding, must also comply with Section 504 as it relates to web accessibility.

Section 255 of the Telecommunications Act of 1996 is another federal law related to web accessibility. It addresses telecommunications products such as telephones, wired and wireless, cell phones and computers, and services, requiring them to be accessible

and usable by people with disabilities. If the services or devices are available at universities, then they need to be accessible. In addition to federal laws, there are state laws and institutional policies that govern web accessibility standards. Institution policies are usually unique to a university and are often linked off of their website. The laws and policies are in place to assist people who may fall into one of the four disability classifications.

Disabilities Categories

Disabilities of people who access web content can be classified into four categories of cognitive, hearing, motor and visual (Web Accessibility in Mind, 2016). Individuals in each category exhibit unique characteristics that may affect how they access and interact with a web page. A review of the characteristics provides insight into the guidelines developers and evaluators can apply in order to improve the accessibility level of university-level websites.

According to Braddock et al. (2004), "Cognitive disabilities entails a substantial limitation on one's capacity to think, including conceptualizing, planning, and sequencing thoughts and action, remembering, interpreting subtle social cues, and understanding numbers and symbols." (p. 49). The category is associated with disabilities that are mentally related. The disability occurs due to inherited genetic traits that affect the physiological and biological structure of the brain. It may also occur due to injuries that affect the physical structure of the brain. Traumatic brain injuries (commonly referred to as *TBI*) may also directly impact mental processes and cognitive abilities.

Cognitive disabilities are diagnosed clinically and include such diagnoses as Attention Deficit Hyperactivity Disorder (ADHD), autism, and dyslexia, and there are

multiple methods of sub-classifying them. However, the common perspectives taken when classifying cognitive disabilities are either to classify them as clinical or functional. Each perspective presents different elements for consideration when a person develops and evaluates web-based information resources for college students. While students may be diagnosed with ADHD, autism, dyslexia, and other learning disorders, the university population can be comprised of individuals who are represented on the broad spectrum of all cognitive disabilities.

An understanding of the different types of cognitive disabilities may influence the selection and usage of web evaluation methods and tools by university administrators and designated web developers. Dyslexia is a disability that affects approximately ten to twenty percent of the population. Acquiring research data about the reading development of older students is vital since among the adult population, there is a considerable number of people with dyslexia who attend institutions of higher education (Saletta, 2018). According to the International Dyslexia Association (n.d.):

> Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede the growth of vocabulary and background knowledge. (para. 1)

Dyslexia is primarily a reading disability that affects both female and male students of many different ethnicities.

When evaluating and developing university web pages, the instruments and methods a person uses to conduct the evaluation should be capable of evaluating the elements of a web page in the context of a person with dyslexia. Expert and user evaluation may address the elements while automated tools will need to be explicitly programmed to account for the different factors. Additionally, the factors should be evaluated in conjunction with other aspects of the page since a person may have more than one disability and be simultaneously impacted by a variety of a page's elements.

ADHD, according to the American Psychiatric Association (APA), affects approximately 2.5 percent of adults (American Psychiatric Associaton, n.d.). Symptoms displayed by someone with ADHD may include, to a greater extent than normal, hyperactivity and inattention. When a student interacts with a web-based resource, the structure and display of information such as graphics and colors can affect his or her ability to maintain attention to the content which can impact retention and usage of the information. During the evaluation of websites, it is helpful to consider ADHD influences in the evaluation process.

In summary, autism, TBI, and learning disabilities each influence how students in university settings engage with web-based resources and the degree to which the resources are accessible to them. Elements of pages that impede student engagement can directly contribute to the level of success a student experiences in the university setting. Designing and programming can address challenges and increase the accessibility of a site for students with cognitive and other disabilities.

The second classified category is hearing disabilities. Hearing disabilities can affect how a person interacts with audio and text content on a web page. While there are varying levels of deafness and hearing loss, content that is presented in an audio-only format may impact a person's response to the page content. Jensen and Øvad (2016), assert that research about the relationship between deafness and reading may reveal how websites can be made more accessible.

The World Health Organization (National Institute of Health, n.d.) Indicates that "over five percent of the world's population have hearing loss" (para. 1). Hearing loss occurs in different degrees and classifications; it ranges from mild to profound loss and can be classified as conductive, neural, high tone, low tone and deaf-blindness. The different levels and classifications can be caused by a variety of reasons such as genetics, infection, trauma and disease (Uy et al., 2013).

The significant number of people who have a hearing loss and the different levels and classifications lend themselves to the need for consideration during the development of web pages. Web content can be made accessible via the use of images, captions and readable text. Considering the different degrees and classifications during design and development assists in the creation of accessible web pages for people with hearing disabilities. Ferguson and Henshaw (2015) pointed out that there is a need to make applications robust and technology factors affecting users may vary due to a person's age.

The third category to consider during design and development is motor disability. A person with a motor disability may have difficulty accessing web pages using standard input devices such as keyboards and mice. The principle to consider during design and development is the operability of the website. Assistive technologies, such as mouth

sticks and voice recognition software, are available for use. The technologies respond in some manner that allows the user to access the web page, yet are commonly needed when the ability-based design may not have been implemented (Wobbrock et al., 2018).

Motor disabilities generally occur due to diseases or injury to the nervous system or different body parts. A few of the different types of motor disabilities are cerebral palsy, essential tremors, muscular dystrophy and spinal cord injuries. This is not an exhaustive list but a sample of types that represent how a person's motor abilities affect the means used to interact with web content. They affect a person's ability to access and interact with web content while using standard devices such as keyboards, mice, microphones and pens. The standard device, as well as assistive technology, may lead to a person experiencing frustration and negative moods when viewing web pages that were are not entirely accessible (Pascual Almenara et al., 2015). However, appropriately matched assistive technologies are strategic design elements can be implemented to alleviate some of the challenges.

Assistive technologies such as eye-tracking software, mouth sticks and voice recognition software can assist in making a person's web experience more effective. The website form and function work in conjunction with the technologies to create a user's experience. Designing and developing while considering the access and input devices different users may employ may result in a site that reduces user frustration and fatigue. Designing pages that reduce a user's input when navigating a site, such as creating hyperlinks that are easily selected and setting pages so they can be easily navigated with a keyboard, are a few of the design considerations that can be built into a site. The design elements that increase a site's operability also make it more accessible.

Visual disabilities are the fourth category to be considered during the development and evaluation of web pages, including the pages utilized via the learning management system (LMS) technology. Suwannawut (2014) recommends to, “Offer consistency in layout and a structured page organization with simple navigation” (p. 189). There is a need to adhere to specific criteria during development that causes web pages used in multiple types of systems to meet the needs of individuals who may have a visual disability.

Visual disability includes levels of vision on a spectrum of low vision to a complete lack of vision. Blindness falls at the end of the spectrum towards a complete lack of vision. To be legally blind, according to the United State government, a person must have a visual acuity of 20/200 or less in the better-seeing eye with the best conventional correction. According to the American Foundation for the Blind (2019), a functional definition of low vision is “uncorrectable vision loss that interferes with daily activities” (para. 11)

Incidents of ow vision and blindness span all age groups and increase as people age (Chan et al., 2018). Considering the broad spectrum of age ranges that access the institution of higher education web pages, there exists different design elements and technologies that may be employed to compensate for visual disabilities. A person may use a screen reader software solution such as JAWS or rely on navigating a web page via keyboard inputs. If a web page design is incompatible with such assistive technology, it can create access issues for individuals to be able to use the site to read content.

Screen readers are effective at reading a web page, yet they cannot inherently describe an image, tab orders or replicate a web page visual layout (Web Accessibility in

Mind, 2017). Poorly designed pages, software issues and many other reported reasons cause time loss and frustration for screen reader users and other website (Lazar et al., 2007). To reduce frustration, developers can enter items in the code, such as alt text, that is readable by the screen reader and describes an image. Figure 1 shows an example of an alternative text applied to an image. The text appears when the cursor hovers over the image. They may also adjust the page navigation structure coding, allowing someone using a keyboard to navigate to the desired area or link quicker, as well as implementing multiple methods of conveying information normally communicated via colors.

Figure 1. Image with alternative text.

Browder (2018) recommends creating accessible PDFs so that images, graphs and charts can be read via a screen reader. Testing a page using a screen reader, keyboard-only, or a combination of the two provides insight into the page's accessibility level for people with visual disabilities. Since many people who use screen readers navigate a page without the use of a mouse, it is beneficial to incorporate testing without certain input devices during the development of pages. However, Freire et al. (2008) report that many developers need development in their skills regarding how to create pages that are accessible by the blind.

Accessibility Guidelines

The Web Content Accessibility Guidelines (WCAG) consist of 12 guidelines with testable success criteria for each guideline developed by various individuals and organizations around the world (Accessibility Guidelines Working Group, 2008). The WCAG 2.0 guidelines listed on the World Wide Web Consortium (W3C) website are as follows (Accessibility Guidelines Working Group, 2008):

- Guideline 1.1 Text Alternatives: Provide text alternatives for any non-text content. Figure 2 shows an example of alternative text applied to a thumbnail image that is used as a hyperlink.

Figure 2. Text alternative applied to a thumbnail image link.

- Guideline 1.2 Time-based Media: Provide alternatives for time-based media. Figure 3 shows an example of captions applied to a video. The captions are an alternative means of obtaining the audio information presented in the video.

Figure 3. Closed captions applied to a video hosted on a web page.

- Guideline 1.3 Adaptable: Create content that can be presented in different ways without losing information or structure. Figure 4 shows an example of a form with required fields and different means of conveying the information is required.

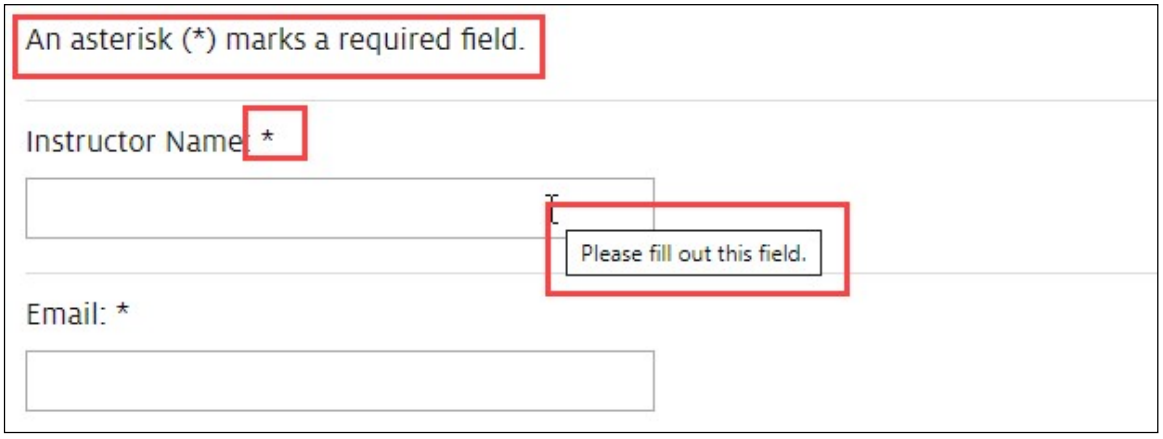

Figure 4. A form with field requirements conveyed through different means.

- Guideline 1.4 Distinguishable: The page content is easier for users to see and hear. Figure 5 shows an example of a zoom function applied to a page. The figure displays the page after it was scaled to 125%.

Admission Requirements

		Minimum Test Scores
Admission Type	**Rank in Class**	**SAT**
Assured Admission	Top 10%	No Minimum
Assured Admission	Top 11 — 25%	1080
Assured Admission	Top 26 — 50%	1170
Individual Review*	51% and Lower or No Rank	Individual Review*

Figure 5. Web page scaled to 125% and retains content after resizing.

- Guideline 2.1 Keyboard Accessible: Make all functionality available from a keyboard. A user visiting a web page can operate the content on the page using a keyboard or emulator. For example, if there is a drag and drop feature on the site, a person viewing the page using a screen touch device may attach a keyboard and be able to move the items on the page with the keyboard.
- Guideline 2.2 Enough Time: Provide users enough time to read and use the content. Examples of the guideline are warning visitors when a page or form expires and allowing the visitor to control timed elements, such as an advertisement or notification on a page, by pausing, starting or stopping them.
- Guideline 2.3 Seizures: Content should not be designed in a manner that causes seizures. No item on a page should flash more than three times in one second.

- Guideline 2.4 Navigable: Provide users with ways to navigate and find content. Figure 6 shows an example of using link text that clearly indicates the purpose of the link and where the link will direct visitors if they select it. The link in the figure indicates the user will be directed to a specific website if they select the Office of the Provost website link.

Shasta goes to Belize City, Belize.

Be sure to tag @uhprovost and add #travelswithshasta on Instagram, tweet @SashaProf, or email provost@uh.edu to share your experiences - in Houston or abroad - with our favorite Coog! View all of Shasta's travels on the Office of the Provost website.

Figure 6. Link text indicating the purpose of a link.

- Guideline 3.1 Readable: Make the text content readable and understandable. The language of the page should be identified by programs such as screen readers or other text-to-speech software. As the software reads a page, the page markup enables the software to identify the language changes. A page may also have links that allow a site visitor to change the language of the page. Figure 7 shows an example of links on a page that afford visitors the opportunity to view other versions of the page.

Figure 7. Alternative language version selection options.

- Guideline 3.2 Predictable: Make the web pages appear and operate in predictable ways. Figure 8 shows an example of placing a search control on a page in a location that remains consistent across multiple pages of a website. In the figure, the search is located on the top right of the page, and this makes it easier for visitors to locate it on repeated visits and when browsing multiple pages within the site. Consistent placement of controls makes the page operate in a predictable way.

Figure 8. Consistent search control location on a website.

- Guideline 3.3 Input Assistance: Help users avoid and correct mistakes. Examples of helping users include adding clear labels to form fields to indicate the type and format of text to enter and formatting the text in a field after a user has input data. After users have input their phone numbers in associated text fields, for example, the form helps users by formatting the input and placing dashes or parentheses in the correct locations of a number string.
- Guideline 4.1 Compatible: Maximize compatibility with user agents, including assistive technologies. Correctly formed page markup, such as opening and closing tags, and the use of standard, not unconventional, code markup allows assistive technology to remain compatible and be able to access web page content. Using standard coding allows user agents that evolve, such as browsers, to be able to recognize coding and access content in an understandable manner.

Additionally, training is available for individuals interested in learning about and utilizing the guidelines during their web-based instructional resource development. In some countries, it is mandatory for websites to follow or meet the guidelines to some degree. According to Hilera et al. (2013), "Several countries have legislation explicitly related to the WCAG guidelines: e.g. the case of Spain" (p. 36).

The guideline authors organized them into four principles, and they have become standards some entities follow, and at times require compliance with, during development and active site hosting. Other developers, while not required to strictly comply with the guidelines, address and use them during the website development process. The guidelines have undergone revision from version 1.0 to 2.0 in order to address changes and enhance standards. While the upgrade version offers improvements, it inherently presents

challenges to organizations that have developed and maintain large-scale websites based on the WCAG 1.0 standards. Challenges include development time, cost, evaluation, and identification of developers who understand and are able to apply the guidelines. Depending on the complexity of the site, updating it to meet new standards may take several months or years. A developer capable of effectively applying the updates may be difficult to locate and retain during the entire update process. The entity undertaking the site redevelopment may incur costs associated with training developers in order for them to become proficient with the new standards and guidelines.

The WCAG 2.0 four principles listed on the World Wide Web Consortium (W3C) website are as follows (Accessibility Guidelines Working Group, 2008):

- Principle 1: Perceivable
    - Information and user interface components must be presentable to users in ways they can perceive.
    - Sites should provide text alternatives for non-text content and captions as well as other alternatives for multimedia elements.
    - Content should be presentable in multiple ways that do not cause a loss in meaning.
- Principle 2: Operable
    - User interface components and navigation must be operable.
    - Content should not cause seizures and site users should have enough time to read and utilize the site content.
    - A user should be able to use a keyboard for all functionality and built-in assistance is provided that helps users navigate and locate content.

- Principle 3: Understandable
    - Information and the operation of user interface must be understandable. The text should be readable and content operates as expected.
    - User assistance is provided to help them avoid and correct mistakes.
- Principle 4: Robust
    - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

Riley-Huff (2012) suggested that, before accessing the myriad of other development resources available, developers should begin the process of creating an accessible site by acquiring an understanding of accessibility standards. Following and utilizing the guidelines, while many times can be beneficial to developers, can be cumbersome and confusing to apply during the design and development process. Farrelly (2011) found that some developers liked the goals of WCAG but did not find it executed well or in user-friendly ways. It can benefit developers to have an understanding of the WCAG principles and guidelines in order to use them in conjunction with other evaluation tools and resources as they comprehensively evaluate their sites. Foley (2011) indicates single evaluation tool usage by developers may result in a website that does not meet the accessibility needs of all site visitors.

Although developers encounter challenges during the interpretation and implementation of the guidelines, the outcomes may be beneficial to users across a broad spectrum of abilities. Karreman et al. (2007) found that websites adapted for intellectual disabilities did not cause site visitors without intellectual disabilities to have adverse experiences. Implementing adaptions and applying guidelines and principles for a unique

group of users may consequently affect all users of the site. While beneficial to users across a broad spectrum of abilities, challenges are present as developers strive to implement current and evolving standards. Including the standards and principles in the daily development practices of individuals creating sites and pages varies according to the diverse abilities of the multitude of developers.

Although guidelines can be very beneficial during development, they may also contain aspects that would benefit from revisions. Federici et al. (2005) indicated that accessibility standards adoption may be related to technology tool use tendencies. Since technology evolves rapidly, it may be difficult to identify tendencies and then establish standards. Further research in this area may reveal that standards for unique populations could be established and their use accepted and incorporated by developers.

Website Evaluation Techniques

Developers and designers employ a variety of techniques to obtain formative and summative evaluation information about the websites they are developing. They may perform evaluations using tools such as the Website Accessibility Evaluation Tool (WAVE) or a web accessibility score metric. According to Parmanto and Zeng (2005), "The WAB metric provides continuous degrees of estimated accessibility" (p. 1400). A continuous reliable and valid feedback tool can assist developers in implementing needed accessibility changes throughout the lifecycle of the website or web page. Alternatively, the evaluations may take place through developer-defined screening techniques using manual tools, user testing, or feature selection and data mining processes. Each method has its strengths and weaknesses; however, a method or combination of methods may be the best evaluation practice to employ in order to facilitate accessible website creation.

Automated evaluation tools. While there are a variety of automated evaluation tools to evaluate a site's accessibility, one of the commonly used tools is WebAIM's WAVE tool. According to information at the WebAIM website, it does not determine if a web page is accessible, but it can help developers during the process of determining the accessibility level of their site (Web Accessibility in Mind, n.d.). In order to use the tool, a developer simply enters a web page address into the online form field of the WAVE tool site, and the tool evaluates the page. After evaluation, the tool presents the results, which a developer may then use to make adjustments and modifications to the site.

The WAVE tool utilizes both Section 508 and WCAG 2.0 guidelines during the web page evaluation process. While it evaluates a page using many aspects of the guidelines, it is incapable of checking every element of the page against the guidelines. A developer seeking to create an accessible site will need to perform further evaluation of the page in conjunction with the WAVE report. This detailed evaluation may identify accessibility issues such as content quantity that is not readily discernable using the WAVE tool.

In addition to the WAVE tool, there is a substantial selection of other automated tools developers may utilize. Browser plugins, desktop applications, and other web-based tools are available for developers to use during their evaluation process. The guidelines each tool utilizes may vary and are a factor to consider when selecting a tool. Masood Rana et al. (2011) show that automated electronic tools used to evaluate websites provides usable data. Given the ease of use of many tools and that some of the tools are free, it is likely that one may become a standard for use during the evaluation process.

Manual screening. In their research around search engine accessibility, Kerkmann and Lewandoski (2012) utilized the Web Accessibility Initiative multi-step method. The method entails defining the evaluation scope, exploring the target website, selecting a representative sample, auditing the sample, and reporting the evaluation findings (WCAG 2.0 Evaluation Methodology Task Force, 2014). A comprehensive evaluation process can involve evaluators with varying degrees of expertise and manual screening. Some of the drawbacks to the process may be the time commitment and resources needed to undertake a full website evaluation.

The Unified Web Evaluation Methodology, developed by participating European organizations, is a methodology that provides a more generalized interpretation of the WCAG guidelines (Unified Web Evaluation Methodology, n.d.), arguing that a comprehensive, detailed methodology may be overwhelming for a web developer creating single pages or small instructional websites and more involved than what is needed by smaller instructional sites and teams of developers. Developers and teams can use it in conjunction with other methodologies or during the formative evaluation process.

Additionally, individual or groups of developers may create and define web page screening protocols. These protocols may meet the unique needs of the developers, as influenced by their perception of what constitutes effect accessibility evaluation. Time to develop screening instruments, selection of existing tools, and monetary costs are all factors that contribute to or influence how and what is ultimately created and used. The benefit is that the evaluation may place greater consideration on the abilities of the user

population. Additional research may be needed to evaluate the validity and reliability of the instruments.

User testing. Designers and developers, in addition to automated and screening methods, may employ a user testing evaluation methodology. In this case, users who may encounter barriers on the website are asked to evaluate the site. The information obtained may reveal barriers for individuals with specific disabilities. A visually impaired person using a screen reader such as JAWS can potentially provide specific barrier feedback about the site. This type of feedback allows the developer to make design-specific modifications to the site.

An obstacle to using this type of evaluation is associated with the availability of individuals who have the time and resources to participate in the evaluation process. If individuals of differing abilities are not available, then evaluation of a site at any time during development can present challenges. It may reduce development and production time if a developer or team must wait until a viable number of users test the site during formative evaluation prior to the continuing creation of site pages.

Feature selection. Researchers such as Ziemba and Piwowarski (2013) state that a survey assessment does not provide enough accuracy and instead prefer to use a feature selection method. This method reduces the number of criteria used to evaluate sites yet provides beneficial feedback to a developer conducting the formative assessment. The feature selection method, while useful and applicable to individuals with resources and aptitude for conducting these types of assessments, may not be beneficial to a developer during their daily practices. It is a method that may generate very useful data and can be used in conjunction with other evaluation procedures and practices.

Website Development Practices

The individuals and groups that develop instructional websites often have varied skill levels and accessibility knowledge and will use a variety of methods and software titles to create the HTML pages, images, and audio files that reside on the site. The software and applications are constantly evolving as well as the tools integrated into them that assist developers as they create sites and pages. Desktop and mobile devices, as well as associated software, have increasingly made it easier for developers to create and update pages. While the applications and software may have a user interface that facilitates accessible design, developers are not always cognizant of the features, nor how to utilize them during their site development. Additionally, the developer may also neglect to use the application or software features that can assist them in evaluating a site or page under development.

Given the disproportionate number of sites failing accessibility guidelines, it is conceivable that many sites are not evaluated or are insufficiently evaluated prior to being placed in production and made available to students. If statutes do not require websites to be accessible, and site users do not notify developers of their needs, then the importance of maintaining an accessible resource may remain unnoticed (Fulton, 2011). Website development and evaluation practices vary and result in many inaccessible sites.

Varying accessibility knowledge and skill level may be a result of the developer's knowledge, motivation, and preparation and attributable to their design practices. Brajnik et al. (2011 concluded, "the level of expertise is an important factor in the quality of accessibility evaluation of web pages" (p. 280). The motivation to increase knowledge

and competences in accessible development in order improve design practices resides with individuals or groups of developers.

Developers utilize various methodologies and techniques in an effort to provide applications and sites that meet accessibility guidelines. Some develop two versions of a site where one is modified in an effort to meet guidelines and the other is created using standard design practices with little to no consideration of guidelines and principles. Applying additional programming techniques, developers sometimes create standard accessibility revisions to sites that can be applied by the user when they visit a page or site. Another technique that may be used is developing a site where refactoring may be implemented by the user. Although there are many different practices, each of these techniques offers an attempt at and results in some form of a site that may address some accessibility guidelines and principles.

Two versions of the same site. Developers may use a technique where they develop two versions of a site in order to address accessibility standards and principles. This entails creating a standard version and an accessible version of the same site. Often the accessible version does not offer the same user experience and benefits as the traditional site. The discrepancy between the two sites may result in a user being at a disadvantage if they view the accessible version of the site. While the accessible version of the site may offer more accessibility features, it does not often meet the broad and varying needs of each user's different abilities.

A drawback to creating two different sites occurs when the developer is tasked with maintaining and updating both versions. Time and effort to ensure that the content on both sites is equivalent can present challenges. Additionally, there remains the issue of

ensuring the content on the accessible site meets guidelines and principle standards. It is an approach that is still utilized today, although other methods and practices may become more prevalent with advancements in hardware and software capabilities.

Dynamic standard transformations. Some developers implement a practice where they code accessibility features into a site and make the features available via a user-selected object or menu. This practice results in a version of the site that has some accessibility features available and instantiated at the users' request. Many times, the features are universal and do not offer the user an opportunity to customize various aspects of the elements. The result is that the site may be more accessible than the traditional original design, yet it may lack many of the features that would enable individual users opportunities to customize it to meet their needs.

Although this method may meet some of the recommended accessibility guidelines and principles, it does not offer a customization element that may better meet the needs of users with differing abilities. Additionally, enabling some of the features may affect navigation and content access. The meaning conveyed via the site, when the accessibility features are enabled, may not be congruent with the meaning conveyed when the features are disabled. This results in a site that has some accessibility but may not fully meet individual user's differing needs. Other methods similar to refactoring, described next, may offer more opportunities for individual customization.

Refactoring. Another method that a developer may employ in order to ensure accessible resources are available for student use is application or site refactoring. Client-side refactoring, according to Garrido et al. (2013), is an option the affords site users the opportunity to meet their own accessibility needs when visiting web pages that have been

programmed for refactoring. The customization option allows the user to have some control over the accessibility of the application or site. When the application or site is customizable, it can potentially better meet the needs of users with varying abilities.

While refactoring places control of the accessibility in the hands of the user, it requires developers to program or code certain features of the site differently than is customary. Once the application or site is created to permit refactoring, there are benefits to the developers as well as the users. Perhaps one of the greatest benefits is that the user can identify barriers to accessibility and rectify them in a manner that they perceive to be useful. Although developers can identify noncompliance with established accessibility principles, they may not consistently design and develop a non-refactoring site in a manner that makes it accessible to a broader range of users.

Website Developers' Accessibility Perceptions

Web developers work within environments ranging from large groups operating in complex political environments to individuals working independently of external influences. The education and expertise level vary from the casual self-educated developer who may occasionally create a page to professionals who are well-educated in web page design and work within the development environment on a daily basis. Given the variety of experience and levels of expertise, it is possible that the beliefs or attitudes toward the need for accessible design also vary amongst developers. In a qualitative study involving web practitioners, Farrelly (2011) found many challenges such as education and support, evolving legal requirements and guideline communication impact the implementation of accessible websites.

A developer may be well-versed, self-motivated, and have a desire to implement accessible websites yet fail to do so due to different factors. The presence of guidelines, such as WCAG, and evaluation methodology and tools does not appear to be sufficient to increase the adoption of accessible design protocols within organizations or individuals. In certain instances, as Masood Rana et al. (2011) indicated, a factor that results in failure to produce accessible sites is developer knowledge.

Given the variance of education, external influences, motivation, and understanding of accessible design importance, it is conceivable that developer's attitudes and beliefs toward accessibility can have a significant impact on the number of websites and pages that are accessible by learners with varying disabilities. Attitudes and beliefs are susceptible to change and may be influenced by many factors during the course of a developer's career.

Self-Regulation

The self-regulation of web designers and developers ultimately affects the degree of a website or web page's level of accessibility. It may influence the amount of programming effort that individuals exude during design and development. Additionally, it will affect the developer's decisions to initiate and follow thru with accessibility evaluations. Given that developers are increasingly voluntarily following guidelines, there may be an increase in the number and quality of accessible sites.

The existence of groups such as WebAIM and other projects dedicated to accessibility best practices is an indicator that individual self-regulation regarding accessible site design has brought to the forefront the desire of web creation professionals to assist each other with the promotion of accessible site design.

Summary

A comprehensive review of the literature indicates that there are multiple factors that may cause a website to be inaccessible to some site visitors. Additionally, the literature shows there are laws and policies in place that institutions of higher education should adhere to in order to ensure websites are compliant and meet web content accessibility guidelines. Disability categories as related to web site access and use were reviewed. Guidelines, evaluation techniques and developer evaluation practices and perceptions are factors that contribute to the attainment of website accessibility. Literature reviewed indicates that websites can, and should be created, to be accessible by everyone.

Chapter III

Methodology

During the course of this chapter, the research design and methodology are described. A descriptive survey methodology was implemented in order to address the research questions posed. An explanation of the context, instrument, method, data collection, participants, reliability and validity, and research questions are provided.

University websites throughout the United States may be comprised of thousands of pages that are developed by numerous people who have a variety of web design and development knowledge, skills and abilities. Many of a university's pages are not accessible to students and other visitors who have different disabilities. Kimmons (2017) found that web pages at institutes of higher education are not meeting basic accessibility levels.

Literature, as well as the prevalence of colleges and universities under review by the Office for Civil Rights (OCR), indicate that many web-based university resources are not accessible (McKenzie, 2018). Currently, there are multiple universities in the United States that are under review by the OCR (Office for Civil Rights, 2019). The objectives of this study were to determine the level of accessibility of public university web pages in the state of Texas as determined by Web Content Accessibility (WCAG) 2.0 guidelines. Data collected in this study may provide useful information that university personnel may use to improve the web experience of those individuals that visit their sites.

Research Questions

1. How accessible are public university college of education and teacher education program web pages in the state of Texas as determined by WCAG 2.0 guidelines?

2. How readable are public university college of education and teacher education program web pages in the state of Texas?
3. Is there a difference in accessibility and readability between web pages of Texas public university colleges of education and their teacher education programs?

Context

The study took place in a setting off of the physical campus locations and outside of the networks of the 26 universities composing the sample. The researcher scanned the web pages and collected data in a home office setting using a desktop computer with a Windows operating system. Data was collected solely by the researcher during a two-week time period in the fall of 2019.

The public-facing web pages were accessed and viewed with the automated evaluation applications. Neither a physical presence on each university campus nor accessing pages via a virtual private network occurred. None of the web pages required login or credentials to view the page content. Each page was scanned in fewer than five minutes and the scan results reflect the state of the page at the time the scan occurred.

Sample

The sample consisted of 26 public universities in Texas that have a college of education and a teacher education program. Data obtained from the Texas Education Agency Accountability System for Educator Preparation (ASEP) Annual Reports yielded information about public university teacher preparation program student completions. A summary table of the data can be accessed on the Texas Education Agency website. The sample consisted of the universities that rank in the top 70%, based on the number of teacher candidates who completed the program requirements in 2017 (n=26). Each

university had 109 – 722 teacher candidates complete a program in 2017. Each university also had 99 – 1,591 candidates admitted in 2017, or previous years, who had not completed or left the program. Purposely selecting Texas public universities with candidate completions of 109 or more afforded the researcher the opportunity to describe the sample and provide indications of accessibility compliance of other universities with teacher education programs.

Public universities were selected since a Texas statute requires that web pages at public institutions of higher education conform to specific WCAG 2.0 standards. The university pages are accessible to the general public and the researcher could evaluate all the pages without firewall restrictions. Obtaining the sample from a defined geographic region that has established compliance requirements resulted in more homogenous data. Public universities in Texas, instead of other geographic regions or states, were selected since the state has a sufficient number of universities offering teacher education programs.

The university web pages evaluated are accessible to the public. The researcher evaluated two web pages, one college of education and one teacher education program web page, from each of the 26 universities. The total number of pages evaluated was 52. Each of the pages evaluated has a unique web address.

Private universities were excluded from the study since some private institutions of higher education in the state of Texas may not meet the requirements that would require them to maintain accessible pages. Currently, there is the potential that a private institution could meet the enrollment and college of education requirement while not meeting the state statute requirements for maintaining accessible pages.

Researcher Characteristics

The researcher is an expert evaluator that has varying, extensive experience in the realm of designing and coding web pages. He has broad knowledge and experience developing accessible web pages in a post-secondary research setting and brings a unique perspective to his work environment regarding designing and developing accessible web pages. One of the primary responsibilities of the researcher during his work at institutions of higher education in the state of Texas was the design and development of web-based resources. He has served as subject matter experts in their field and provided assistance and consulting to peers both within and external to the university setting.

Limitations

The study had some limitations related to data collection timeframes and techniques. Limitations to data collection existed as the researcher attempted to collect data from multiple pages over a two-week timeframe. During the timeframe, some pages may not have contained significant data, or were currently in development or revision, at some of the universities selected for participation in the study. The programming of any page or template applied to a page of a website, selected for evaluation may have changed over the brief timeframe in which the data was collected.

Another limitation is using one evaluation technique to obtain accessibility data about different web pages. Using other techniques such as manual screening and user testing, in addition to automated evaluation tools, would yield a more robust data set. Time constraints resulted in a limitation since other techniques, such as manual screening, could not be conducted within the time frame of the study.

Research Design

The researcher addressed the research questions in this study via a descriptive survey study. The study was designed to gather data that can be used to describe the accessible state of public university college of education and teacher education web pages as well as the consistency in accessibility between the two groups pages. The literature reviewed prior to initiating the study indicates that data about the WCAG 2.0 guidelines are useful in determining the accessibility level of a web page. The standards incorporated in the guidelines provide information about the elements of web pages that indicate accessibility.

The researchers evaluated 52 web pages and collected data using an automated web accessibility evaluation tool and automated readability checker. The web accessibility evaluation tool and success criteria data provided insight into the current state of web pages and also yield summary data to analyze measures of central tendency. The researcher used the data collected to answer the research questions. The mean, median, mode, deviance from the mean and variation about WCAG 2.0 guidelines and success criteria were gleaned from the data and used to describe accessibility principles.

Multiple guideline variables related to accessibility principle success criteria are available for analysis. The researcher collected data from each page about the different variables. He analyzed the data collected from the accessibility evaluation instrument to determine the accessibility of the college of education and teacher education pages to determine if there are is consistency between the accessibility levels of the different pages. Calculations of the numeric variable provided the researcher with the information needed to answer the research questions.

For the purposes of this study, the researcher used SPSS Statistics software to analyze the collected data. Descriptive statistics were conducted to identify measures of central tendency, variability and frequency distribution. Paired samples t test and correlations were used to investigate the consistency in accessibility and readability of College of Education and Teacher Education Program webpages. The researcher analyzed the tendencies and used the information to make important recommendations about web accessibility at institutions of higher education. The analysis revealed areas where further study could be conducted to yield information that can be used to improve web page accessibility. Further research may yield findings that web developers and university administrators may use to improve the accessibility of their sites for both current and future students.

Instruments

The researcher used multiple instruments to collect data. He used the data collected from the instruments to answer the research questions. The automated evaluation instruments used are SortSite Desktop and Readable. While there is a multitude of automated accessibility scanners available to web designers and developers, the researcher chose SortSite due to the type of report information generated when a page is scanned as well as the options available to set accessibility scan parameter options. The scan options were set at WCAG 2.0 AA and Section 508. The researcher could also select to scan individual pages.

The summary generated after a scan categorized issues and errors identified: accessibility was one of the categories. The accessibility category expanded to identify issues present on the page at either level A or level AA of the accessibility guidelines.

State of Texas institutions of higher education websites should meet WCAG 2.0 Level AA standards. Guideline 1.2 related to time-based media can be excluded.

The researcher could then expand the identified accessibility issues to view the specific issue and line where it occurred on a page. Additionally, a link to the accessibility guideline and failure information on http://www.w3.org/ was present. Information at the links yielded further insight into the criterion that caused a page to fail at level A or level AA, as well as the web content accessibility guideline that did not meet WCAG 2.0 success criteria.

The items scanned in the SortSite instrument reflect the guidelines established by the World Wide Web Consortium (Accessibility Guidelines Working Group, 2008). The international consortium establishes web development standards. The WCAG is organized to align the principles which guide the creation of web pages that are accessible. The four principles are perceivable, operable, understandable and robust. Each principle is further defined by guidelines and the success criteria that must be met to successfully meet the criteria. Figure 9 shows the principles and their associated guidelines. The first principle is perceivable and success is defined by the extent to which the information and interface of a web page can be perceived by the user. It consists of four guidelines and 22 WCAG 2.0 success criteria.

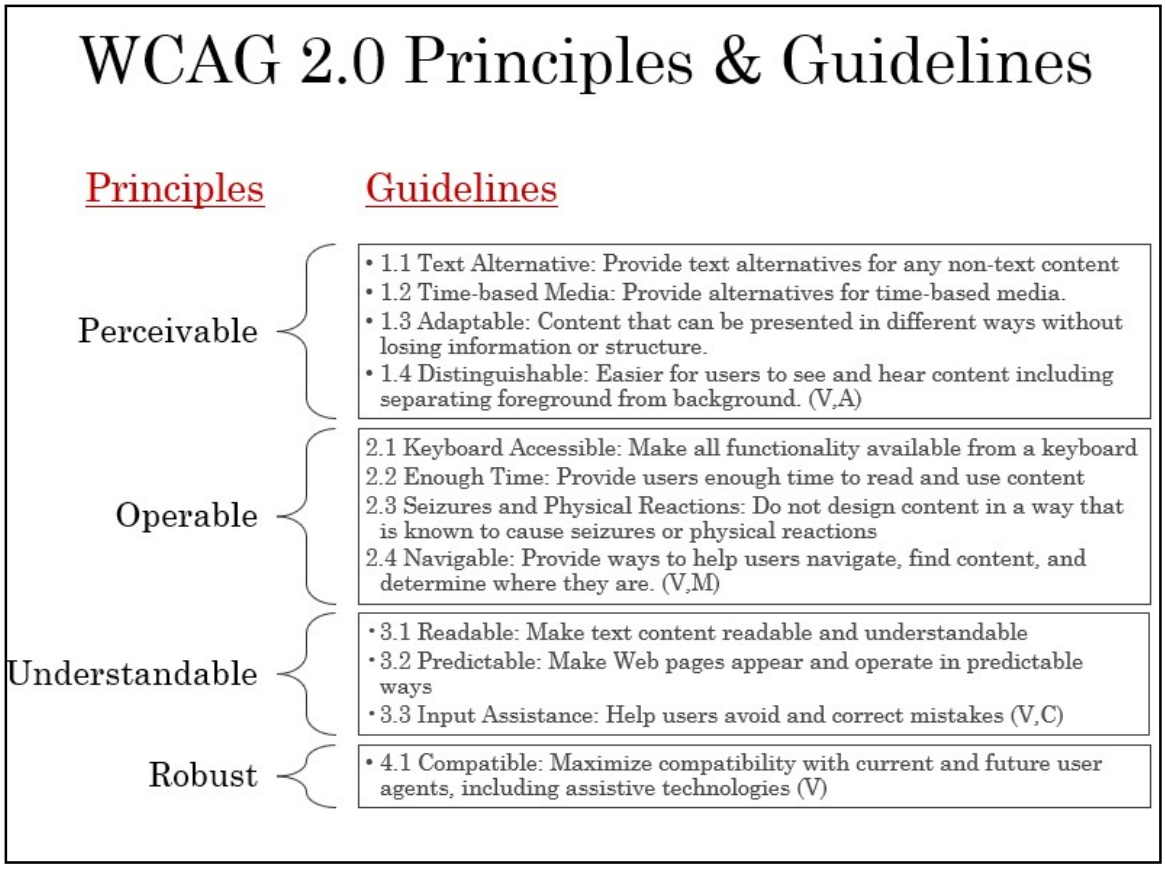

Figure 9. WCAG 2.0 Principles and Guidelines

The second principle is operable and success criteria are defined by the extent to which web user interface elements and navigation operable by the page viewer. It too consists of four guidelines and 20 WCAG 2.0 success criteria.

The third principle is understandable and success criteria are defined by the extent to which the page viewer can understand the information on the page as well as the interface. It consists of three guidelines and 17 WCAG 2.0 success criteria.

The fourth principle is robust and success criteria are defined by the extent to which the content can reliably be interpreted by a variety of user agents including assistive technologies. It consists of one guideline and two WCAG 2.0 success criteria.

The 12 guidelines are comprised of 25 Level A criteria and 13 Level AA criteria. Level A and Level AA criteria will be checked due to the manner in which conformance is established. A page that conforms at Level A satisfies all the success criteria for Level A. A page that conforms at Level A satisfies all the success criteria for Level A and Level AA. The researcher evaluated each page for conformance at Level AA.

Additionally, he used a web browser such as Chrome or Internet Explorer to view pages in order to identify elements of the different pages. For the purposes of this study, compiled success criteria data was recorded by the researcher on an Excel spreadsheet. As data were collected from the automated checker it was entered into an Excel spreadsheet and then imported into SPSS for analysis.

The researcher also collected data about the pages' reading grade level and reading ease using Readable, an automated web page scanning software. He entered the 52 unique web address on a spreadsheet and then uploaded it to the online Readable application and scanned the pages. The data generated from the scans denoted the Flesch Kincaid grade level and readability rating of A through E. The Readable application returned a file containing the information in a format that the researcher could import into SPSS.

Data Collection

For the purposes of this study, the researcher analyzed guidelines and success criteria data using SPSS Statistics software. During data collection, the researcher collected data using an automated accessibility checker titled SortSite. Each page was scanned individually and each WCAG 2.0 guideline pass or fail indication was entered on to a spreadsheet. The data was retained in an electronic medium. The researcher collected

data by evaluating one page at a time. Upon completion of evaluating all pages, the evaluator's responses on the spreadsheet were imported into SPSS and prepared for analysis.

To obtain the data, the evaluator entered the universal resource locator (URL) of a university main web page he was evaluating into the address bar of SortSite and accessed the page. He selected the rules the application used during analysis and then initiated the automated check. When the check was complete the results were presented and the guideline variables were marked as either passed or failed on the spreadsheet. A 1 indicates the page passed the accessibility scan and a 0 indicated the page failed the scan.

There is a timeframe in the fall of 2019 in which the researcher collected the data. At the conclusion of the timeframe, the researcher began compiling and entering the checklist data into SPSS. After the checklist data was collected, and the data had been entered into the SPSS software, the researcher commenced the analysis of the data. No further data collection occurred once the analysis began. The university websites were no longer scanned to collect data regarding their level of web accessibility.

Summary

The research questions centered on describing accessibility and reading levels of the public college of education and teacher education web pages at public universities in Texas. Automated accessibility and readability scans provided data that the researcher analyzed to obtain measures of central tendency and correlations. The data was used to identify relationships as well as describe the passing or failure frequency of WCAG 2.0 guidelines. Passing or failing guidelines information is instrumental in describing the accessibility of the web pages. Reading level data was contributory towards describing

the web pages readability as well as identifying relationships with accessibility guidelines. The next chapter provides a discussion and explanation of the findings from the scans.

Chapter IV

Research Findings

During the course of the study, the researcher used the SortSite Desktop and online Readable tools to collect data about multiple variables in an effort to provide insight into an answer to the posed research questions. The research questions were as follows:

4. How accessible are public university college of education and teacher education program web pages in the state of Texas as determined by WCAG 2.0 guidelines?
5. How readable are public university college of education and teacher education program web pages in the state of Texas?
6. Is there a difference in accessibility and readability between web pages of Texas public university colleges of education and their teacher education programs?

The data collected yielded information about the 52 pages adherence to WCAG 2.0 principles as well as their readability grade levels and ratings. Findings of the data analyzed provided information that is beneficial in addressing the question as well as raising additional questions for further research.

The researcher obtained the data by scanning each of the unique URLs associated with the college of education pages (n=26) and the teacher education program pages (n=26). At the conclusion of each page scan, the researcher noted on the spreadsheet whether or not the page had passed or failed each of the 12 guideline criteria. A zero indicates the page failed the guideline and a one indicates the page passed the guideline. Additionally, each page was coded to indicate its association with the college of education or teacher preparation program group. Each of the 52 pages was scanned and

their respective data entered on the spreadsheet. The spreadsheet was then imported into SPSS for analysis.

Automated Accessibility Scan

After importing the data, a descriptive statistical analysis yielded information about the WCAG 2.0 guidelines frequency, means and standard deviation for both the college of education and teacher education program web pages. Table 1 shows the passing mean and standard deviation of each of the 12 guidelines. See Appendix A for a definition of the guidelines.

Table 1

Web Page WCAG 2.0 Guideline Accessibility Scan Passing Characteristics

Guideline	College of Education			Teacher Education	
	M	SD		Mean	SD
1.1	.65	.485	1.1	.62	.496
1.2	.92	.272	1.2	.88	.326
1.3	.62	.496	1.3	.58	.504
1.4	.27	.452	1.4	.35	.485
2.1	.85	.368	2.1	.88	.326
2.2	.92	.272	2.2	.85	.368
2.3	1.00	.000	2.3	1.00	.000
2.4	.27	.452	2.4	.35	.485
3.1	.96	.196	3.1	.96	.196
3.2	.96	.196	3.2	.96	.196
3.3	1.00	.000	3.3	.96	.196
4.1	.08	.272	4.1	.15	.368

Note. The number of College of Education pages scanned for each guideline was 26 (n=26). The number of Teacher Education pages scanned for each guideline was 26 (n=26).

The data indicates that for the college of education and teacher education programs guideline 2.3 passed on the automated web accessibility scans of all pages (n=52). This suggests that each of the pages met WCAG 2.0 guideline 2.3 regarding

seizures. None of the pages were designed in a manner that may cause seizures or physical reactions.

The data also indicated that for the college of education and teacher education programs guideline 4.1 had the fewest number of pages that met the guideline criteria when scanned with the automated web accessibility scanner. This suggests that the majority of the pages are not robust and present challenges to people attempting to view the page with assistive technology and other user agents.

The remaining 10 WCAG 2.0 guidelines that represent a web page accessibility compliance had means that fell between the means of guideline 2.3 and guideline 4.1. The frequency data of each of the twelve WCAG 2.0 guidelines are presented below along with an analysis of the data contained in each set of variable tables.

The data in Table 2 shows that the college of education and teacher education program web pages comply with WCAG guideline 1.1 at a similar frequency. Text alternatives for all non-text content on the page are present on more than 60 % of the pages while fewer than 40% of the pages do not have a text alternative for all non-text content.

Table 2

Frequency Distribution of Ratings on WCAG 2.0 Guideline 1.1 - Text Alternatives

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	9	34.6	10	38.5
Passed	17	65.4	16	61.5

As shown in Table 3, the college of education and teacher education program web pages comply with WCAG guideline 1.2 at a similar frequency. Alternatives for time-

based media such as captions are present on more than 88 % of the pages while fewer than 12% of the pages do not have alternatives

Table 3

Frequency Distribution of Ratings on WCAG 2.0 Guideline 1.2 - Time-based Media

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	2	7.7	3	11.5
Passed	24	92.3	23	88.5

The data in Table 4 suggests that the college of education and teacher education program web pages comply with WCAG guideline 1.3 at a similar frequency. Content on the pages capable of being presented in different manners is present on more than 57 % of the pages while fewer than 42% of the pages do not have adaptable content.

Table 4

Frequency Distribution of Ratings on WCAG 2.0 Guideline 1.3 - Adaptable

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	10	38.5	11	42.3
Passed	16	61.5	15	57.7

The data in Table 5 suggest that the college of education and teacher education program web pages comply with WCAG guideline 1.4 at a similar frequency. Content on the pages that is distinguishable by people accessing the page is present on fewer than 75 % of the pages. Fewer than 35% of the pages have distinguishable content.

Table 5

Frequency Distribution of Ratings on WCAG 2.0 Guideline 1.4 - Distinguishable

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	19	73.1	17	65.4
Passed	7	26.9	9	34.6

The data in Table 6 shows that the college of education and teacher education program web pages comply with WCAG guideline 2.1 at a similar frequency. The interface is operable and a person visiting the page can navigate it with a keyboard. Operability is present on more than 84 % of the pages scanned and fewer than 16% had an element of the page that was inoperable.

Table 6

Frequency Distribution of Ratings on WCAG 2.0 Guideline 2.1 - Keyboard Accessible

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	4	15.4	3	11.5
Passed	22	84.6	23	88.5

The data in Table 7 shows that the college of education and teacher education program web pages comply with WCAG guideline 2.2 at a similar frequency. There is enough time for a person visiting the page to read and use the page content (Accessibility Guidelines Working Group, 2008). Enough time is available on more than 84 % of the pages scanned and fewer than 16% had an element of the page that had a time issue.

Table 7

Frequency Distribution of Ratings on WCAG 2.0 Guideline 2.2 - Enough Time

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	2	7.7	4	15.4
Passed	24	92.3	22	84.6

The data in Table 8 suggest that the college of education and teacher education program web pages comply with WCAG guideline 2.3 at a similar frequency. On 100% of the pages scanned, content on the page is not designed to cause seizures.

Table 8

Frequency Distribution of Ratings on WCAG 2.0 Guideline 2.3 - Seizures

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	0	0	0	0
Passed	26	100	26	100

The data in Table 9 shows that the college of education and teacher education program web pages comply with WCAG guideline 2.4 at a similar frequency. All the elements of a page are navigable on 35% or fewer pages

Table 9

Frequency Distribution of Ratings on WCAG 2.0 Guideline 2.4 - Navigable

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	19	73.1	17	65.4
Passed	7	26.9	9	34.6

The data in Table 10 suggest that the college of education and teacher education program web pages comply with WCAG guideline 3.1 at a similar frequency. Greater than 96% of the pages contain text content on the page that is readable according to W3C WCAG 2.0 by people accessing the pages. Fewer than 4 % of the pages contain content that is unreadable or understandable.

Table 10

WCAG 2.0 Guideline 3.1 - Understandable

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	1	3.8	1	3.8
Passed	25	96.2	25	96.2

The data in Table 11 suggest that the college of education and teacher education program web pages comply with WCAG guideline 3.2 at a similar frequency. Greater than 96% of the pages appear and operate in a predictable manner according to W3C WCAG 2.0 by people accessing the pages. Fewer than 4 % of the pages contain content that behaves unpredictably.

Table 11

Frequency Distribution of Ratings on WCAG 2.0 Guideline 3.2 - Predictable

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	1	3.8	1	3.8
Passed	25	96.2	25	96.2

The data in Table 12 suggest that the college of education and teacher education program web pages comply with WCAG guideline 3.3 with a similar frequency distribution. Greater than 96% of the pages provide input assistance that helps users who input inaccurate information. Fewer than 4 % of the pages contain content that does not provide input assistance.

Table 12

Frequency Distribution of Ratings on WCAG 2.0 Guideline 3.3 - Input Assistance

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	0	0	1	3.8
Passed	26	100	25	96.2

The data in Table 13 suggest that the college of education and teacher education program web pages meet WCAG guideline 4.1 success criteria at a similar frequency. Fewer than 16% of the pages, either college of education or teacher education program pages, contain robust content that is usable with assistive technology and other user agents.

Table 13

Frequency Distribution of Ratings on WCAG 2.0 Guideline 4.1 - Compatibility

Scan Result	College of Education		Teacher Education	
	f	%	f	%
Failed	24	92.3	22	84.6
Passed	2	7.7	4	15.4

Data obtained from the SortSite electronic accessibility site scanner provided information about each of the 12 WCAG 2.0 guidelines that the researcher used to

answer the research questions. The questions focused on describing how accessible public university colleges of education and teacher education program web pages in the state of Texas are as determined by WCAG 2.0 guidelines and readability indicators. The frequency statistics data suggests that the 26 colleges of education and teacher education web pages are similar in successfully passing the success criteria for each of the 12 WCAG 2.0 guidelines.

Successfully passing a guideline indicates that a page meets the success criteria that make it accessible for the specific guideline. The data suggests that most of the pages meet the guideline requirements that result in a page being perceivable, operable and understandable. However, failing to pass guideline 4.1 success criteria indicates that a page is not robust. Most of the pages failed to meet the guideline 4.1 criteria.

Automated Readability Scan

Additional data that may assist in describing the current accessible state of the pages was obtained from an automated electronic readability scan that checked the reading characteristics of the page. The online Readable application was used to scan the pages and generate readability data. The 52 unique web addresses were placed on a spreadsheet and then uploaded to the online Readable application and scanned. The data generated from the scans denoted the Flesch Kincaid grade level and readability rating of A through E. The grade level and readability rating are discussed in relation to accessibility.

According to Child (n.d.), the letter grades are a Readable score that rates how easy or hard the web page text is to read. The text is ranked in difficulty from A to E. Each of the colleges of education and teacher education pages was rated and assigned a

rating. Table 14 and Table 15 show the readability rating frequency data for both the college of education (n=26) and teacher education (n=26) pages. In the two tables, A is coded as 1, B as 2, C as 3, D as 4 and E as 5.

The two pages of one college could not be successfully scanned, resulting in a total of 50 pages scanned by Readable. According to the scan results, 77% of the college of education pages had a B, C or D rating while 84.7% of the teacher education pages had a B, C or D rating.

Table 14

Frequency Distributions of College of Education Readability Ratings

Rating	f	%	Valid Percent	Cumulative Percent
1	1	3.8	4.0	4.0
2	6	23.1	24.0	28.0
3	8	30.8	32.0	60.0
4	6	23.1	24.0	84.0
5	4	15.4	16.0	100.0
Total	25	96.2	100.0	

Table 15

Frequency Distributions of Teacher Education Readability Ratings

Rating	f	%	Valid Percent	Cumulative Percent
2	6	23.1	24.0	24.0
3	8	30.8	32.0	56.0
4	8	30.8	32.0	88.0
5	3	11.5	12.0	100.0
Total	25	96.2	100.0	

Additional data from the scan indicates there is a slight skew to the right of the college of education and teacher education pages as shown in Figure 10 and Figure 11. This suggests that a normal distribution of ratings is present across both the college of education and teacher education pages.

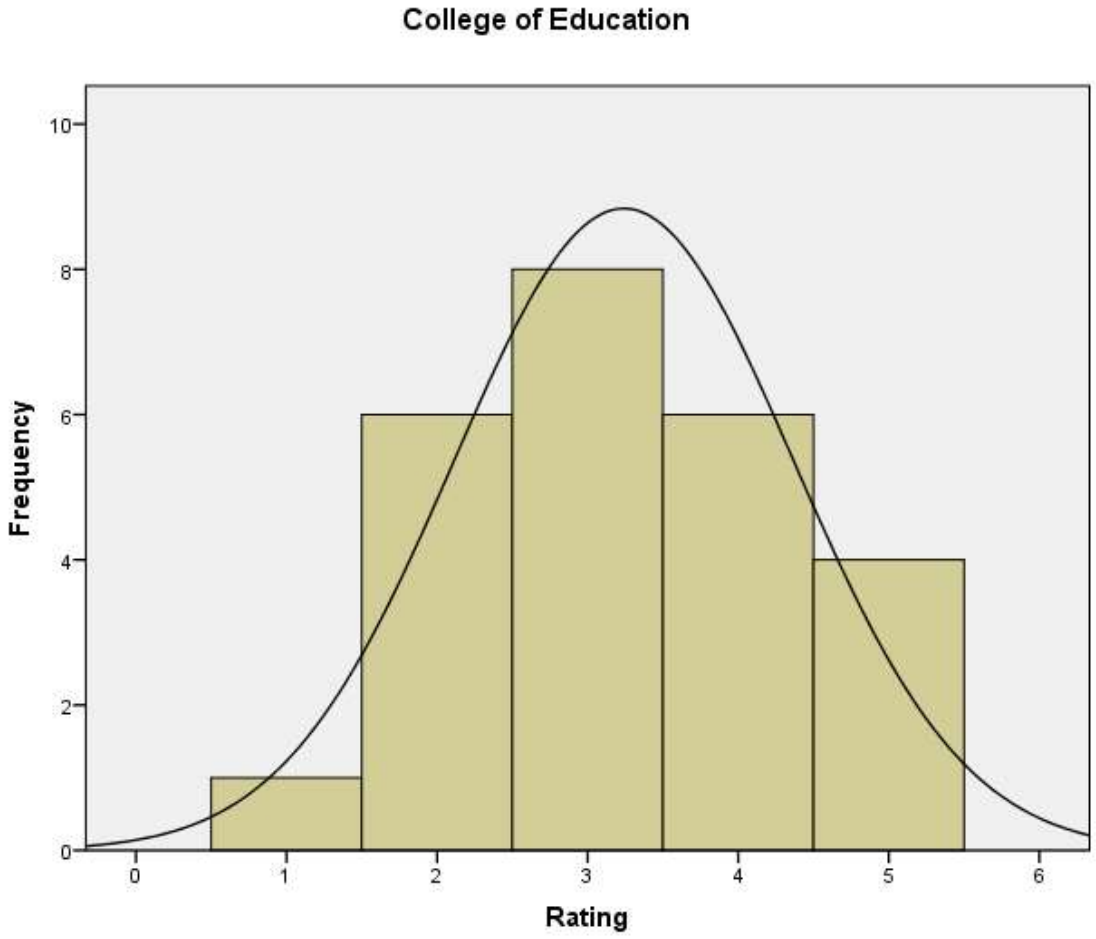

Figure 10. Histogram of College of Education Readability Ratings

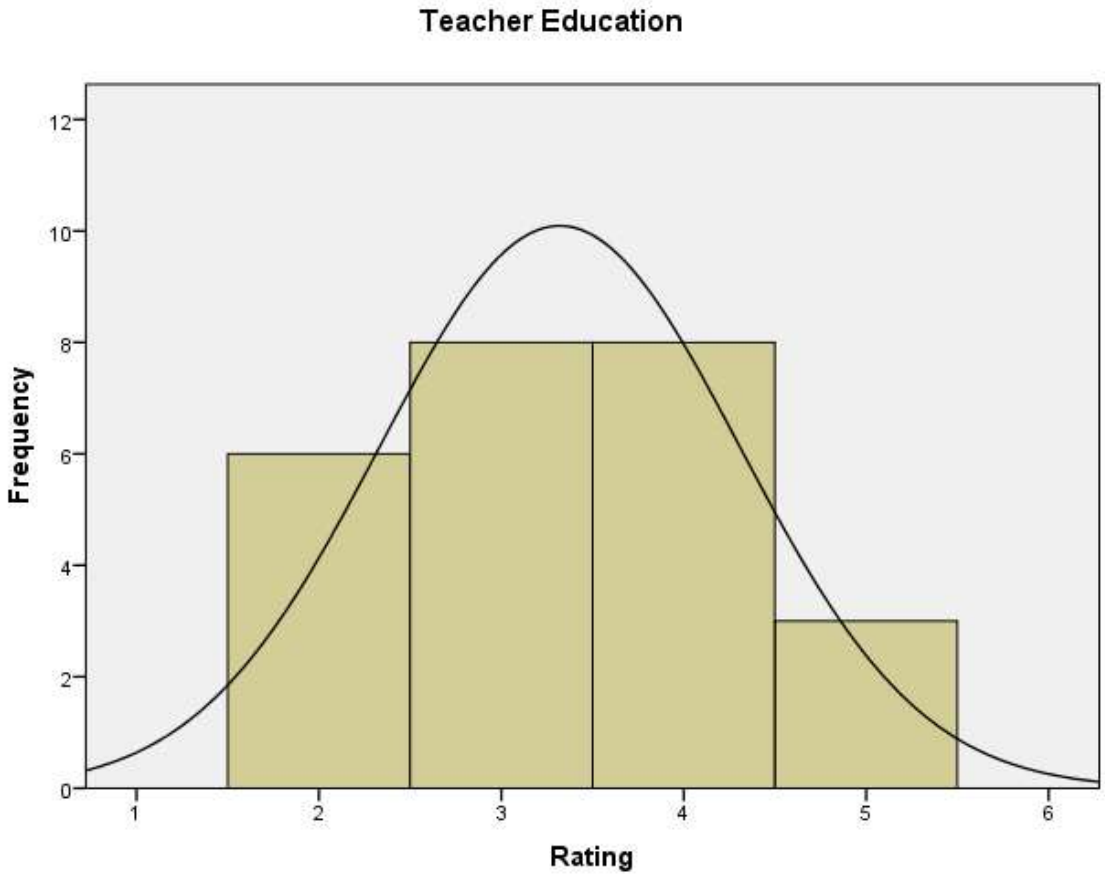

Figure 11. Histogram of Teacher Education Readability Ratings

The Readable scans of the websites also yielded data about the Flesch Kinkaid reading grade level of each page. Inclusive of the 52 pages scanned, the grade levels varied from a minimum of 7.3 to a maximum of 18. The college of education pages (n=25) had a mean reading level of 11.44 and the teacher education pages (n=25) had a mean reading level of 11.66. A website's readability level impacts site users information acquisition Schutten and McFarland (2009). Flesch-Kincaid is a commonly used reading score.

Figure 12 shows that there is a slight skew to the right of the college of education grade levels present on the pages. Figure 13 shows that there is a greater skew to the right

of the grade levels present on teacher education pages. This suggests that a fairly normal distribution of reading grade levels is present across the college of education pages. The teacher education pages are more skewed more to the right than the college of education pages. The reading level is lower on teacher education pages than on college of education pages

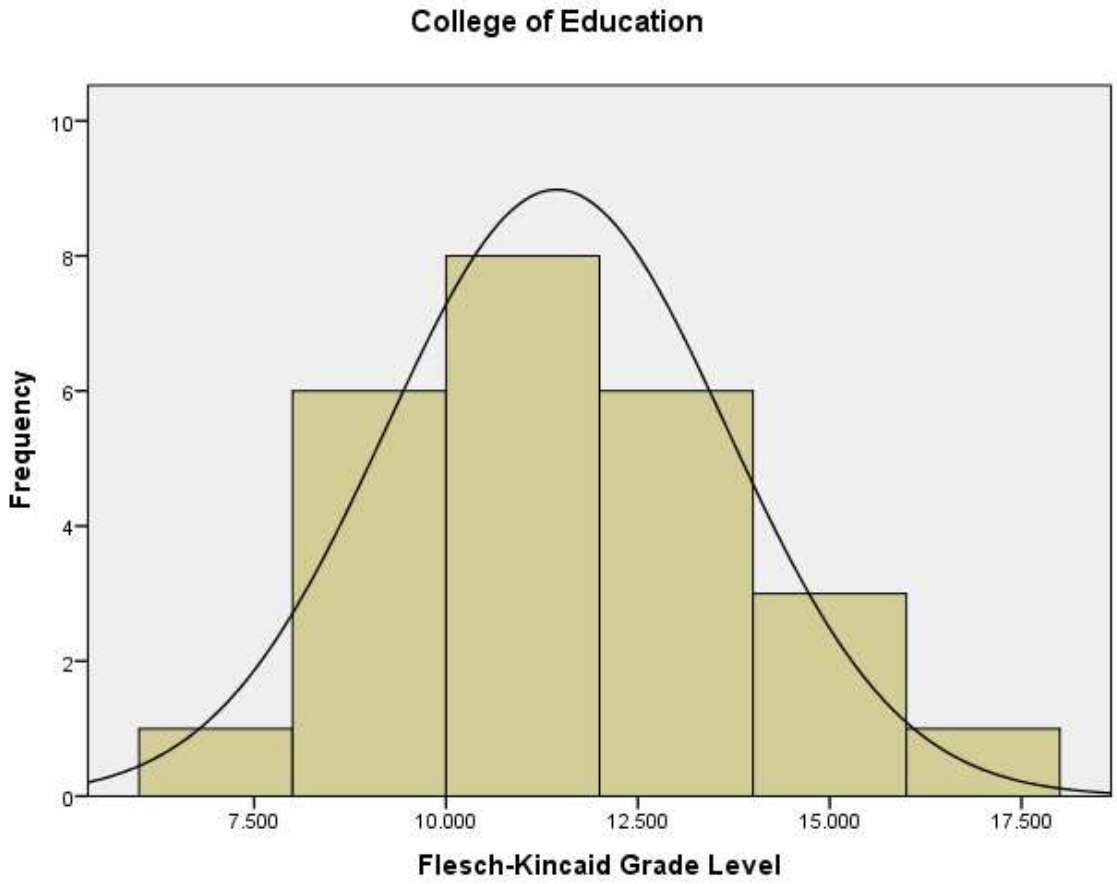

Figure 12. College of Education Flesch-Kincaid Grade Level Histogram

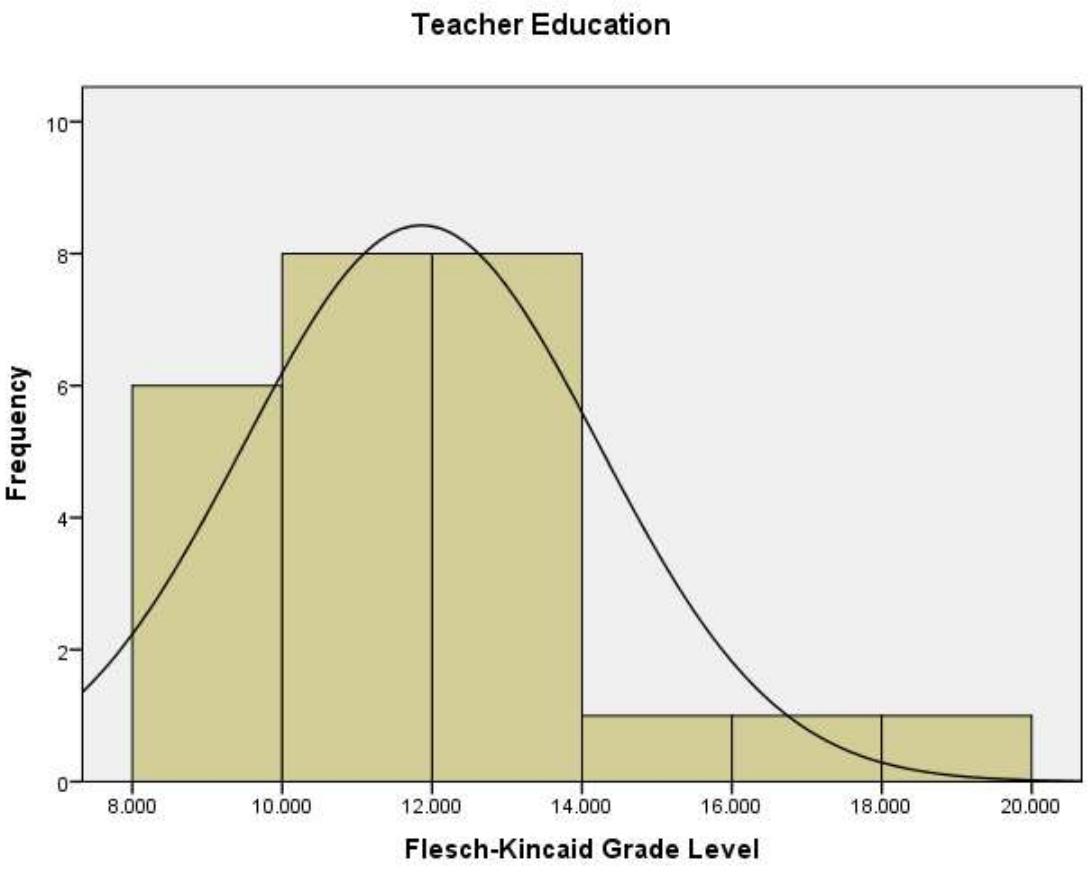

Figure 13. Teacher Education Flesch-Kincaid Grade Level Histogram

The data obtained from the readability scanner in conjunction with data obtained via the accessibility scanner can provide a broader visualization of page accessibility. When examining readability data, it seems to relate most closely with WCAG 2.0 guideline 3.1 about displaying content on a page that is readable and understandable. Guideline 3.1 resides under understandable accessibility principles and centers on ensuring content on web pages is readable and understandable.

Consistency on Readability Indicators between COE and TE Web Pages

A paired-samples t-test was conducted to evaluate whether the Flesch-Kincaid reading grade levels and readability ratings differed significantly between the college of education web pages and teacher education web pages. The results are displayed in Table

16. The results indicated there was not a statistically significant difference in the Flesch-Kincaid reading grade level or readability rating of the college of education and teacher education web pages, $p > .05$. The t-test suggests that the college of education and teacher education pages have similar reading levels and readability ratings.

Table 16

Paired Samples t Test Results for College of Education and Teacher Education Flesch-Kincaid Reading Grade Level and Readability Rating

Readability Measure	Paired Page Source	M	SD	T	p
Flesch-Kincaid	COE - TE	-.41600	3.14771	-.661	.515
Readability Rating	COE - TE	-.08000	1.41185	-.283	.779

Note. COE stands for College of Education and TE stands for Teacher Education. df = 24 for each readability measure.

A Pearson product-moment correlation coefficient was computed to assess the relationship between the college of education and teacher education web page's Flesch-Kincaid reading grade levels. There is a moderate relationship between the two variables, r=.059, n=25, p = .584. Increases in a college of education's web page Flesch-Kincaid reading grade level moderately correlate with increases in a teacher education web page Flesch-Kincaid reading grade level.

A Pearson product-moment correlation coefficient was computed to assess the relationship between the college of education and teacher education web pages readability ratings. There is a strong relationship between the two variables, r=.115, n=25, p =. 778. Increases in a college of education's web page readability rating strongly correlate with increases in a teacher education web page readability rating.

A Point-Biserial Correlation coefficient was computed to assess the relationship between Flesch-Kincaid grade level and passing the WCAG 3.1 guideline scan of the

college of education web pages. There is a weak relationship between the two variables. [r=.229, n=25, p=.271]. Increases in college of education web page Flesch-Kincaid grade level are weakly correlated with passing the WCAG 3.1 scan.

A Point-Biserial Correlation coefficient was computed to assess the relationship between Flesch-Kincaid grade level and passing the WCAG 3.1 guideline scan of teacher education web pages. There is a weak relationship between the two variables. [r=.067, n=25, p=.752]. Increases in college of education web page Flesch-Kincaid grade level are weakly correlated with passing the WCAG 2.0 guideline 3.1 scan.

Accessibility Principles

Web Content Accessibility Guidelines 2.0 are organized into different levels of guidance. At the top level are the four principles, perceivable, operable, understandable and robust. At the level below the principles are the 12 guidelines that provide guidance for developers as they attempt to create accessible web pages. Four guidelines, 1.1 – 1.4, are associated with the perceivable. Four guidelines, 2.1 – 2.4, are associated with the operable principle. Three guidelines, 3.1 – 3.2, are associated with the understandable principle and one guideline, 4.1, is associated with the robust principle.

Testable success criteria associated with each guideline can be used to determine if a web page passes or fails a guideline. The success criteria of pages in the study were scanned and a guideline pass or fail indication was obtained from the scan. Grouping the guideline variables by principle provides insight into how accessible public university colleges of education and teacher education program web pages in the state of Texas are as determined by WCAG 2.0 guidelines.

A review of the data in Table 17 indicates that 88.5% of the college of education pages, and 76.9% of teacher education pages, passed three out of the four guidelines associated with the perceivable principle. This suggests that the college of education pages are more accessible 75% of the time to people with disabilities related to perceiving elements of a page. While most of the page elements are accessible to individuals with disabilities that may be affected by perceivable elements, some parts of a page may not be accessible.

Table 17

Perceivable Principle: College of Education and Teacher Education Passing Guidelines 1.1-1.4.

Guidelines Passed	College of Education			Teacher Education		
	f	%	CP	f	%	CP
0	1	3.8	3.8	1	3.8	3.8
1	3	11.5	15.4	5	19.2	23.1
2	8	30.8	46.2	8	30.8	53.8
3	11	42.3	88.5	6	23.1	76.9
4	3	11.5	100.0	6	23.1	100.0

Note. CP stands for Cumulative Percentage

A review of the data in Table 18 shows that 73.1% of the college of education pages, and 69.2% of teacher education pages, passed three out of the four guidelines associated with the perceivable principle. This suggests that the college of education pages are more accessible 75% of the time to people with disabilities related to operating elements of a page. While most of the page elements are accessible to individuals with disabilities that may be affected by operable elements, some parts of a page may not be accessible.

Table 18

Operable Principle: College of Education and Teacher Education Pages Passing Guidelines 2.1 – 2.4

Guidelines Passed	College of Education			Teacher Education		
	f	%	CP	f	%	CP
1	1	3.8	3.8	1	3.8	3.8
2	4	15.4	19.2	4	15.4	19.2
3	14	53.8	73.1	13	50.0	69.2
4	7	26.9	100.0	8	30.8	100.0

Note. CP stands for Cumulative Percentage

A review of the data in Table 19 shows that 92.3% of the college of education pages, and 88.5% of teacher education pages, passed three out of the three guidelines associated with the understandable principle. While most of the page elements are accessible to individuals with disabilities that may be affected by understandable elements, some parts of a page may not be accessible.

Table 19

Understandable Principle: College of Education and Teacher Education Pages Passing Guidelines 3.1 – 3.3

Guidelines Passed	College of Education			Teacher Education		
	f	%	CP	f	%	CP
2	2	7.7	7.7	3	11.5	11.5
3	24	92.3	100.0	23	88.5	100.0

Note. CP stands for Cumulative Percentage

A review of the data in Table 20 shows that 92.3% of the college of education pages, and 84.6% of teacher education pages, failed the guideline associated with the robust principle. This suggests that the college of education pages are less accessible

more frequently than teacher education pages to people with disabilities related to robust elements of a page. While most of the page elements are not accessible to individuals with disabilities that may be affected by robust elements, some parts of a page may be accessible.

Table 20

Robust Principle: College of Education and Teacher Education Pages Passing Guideline 4.1

Guidelines Passed	College of Education			Teacher Education		
	f	%	CP	f	%	CP
0	24	92.3	92.3	22	84.6	84.6
1	2	7.7	100.0	4	15.4	100.0

Note. CP stands for Cumulative Percentage

A paired-samples t-test was conducted to evaluate whether the four WCAG 2.0 principles pass rates differed between the college of education web pages and teacher education web pages. The results are displayed in Table 21. The results indicate there was not a statistically significant difference in the WCAG 2.0 principles pass rates of the college of education and teacher education web pages. The t-test suggests that the college of education and teacher education pages have similar pass rates.

Table 21

Paired Samples t Test Results for WCAG 2.0 College of Education and Teacher Education for each Accessibility Principle

WCAG 2.0 Principle	Paired Page Source	M	SD	t	p
Perceivable	COE - TE	.03846	1.24838	.157	.876
Operable	COE - TE	-.03846	.59872	-.328	.746
Understandable	COE - TE	.03846	.19612	1.000	.327
Robust	COE - TE	-.07692	.39223	-1.000	.327

Note. COE stands for College of Education and TE stands for Teacher Education. df=25 for each Principle.

Summary

Through the course of this chapter the data acquired that was used to describe the accessibility and reading levels of the college of education and teacher education pages was presented and discussed. The data was analyzed and correlations and t-test information were described. Web page data about the WCAG 2.0 principle and guideline information, described in the review of literature, were summarized along with reading level data. Data obtained from the scans on the guideline suggest that the college of education and teacher education pages did not differ significantly in their pass rates and or readability levels. In the next chapter a summary of the findings, their implications for practice and recommendations are presented.

Chapter V

Discussion

Technology has revolutionized how institutions of higher education provide information to people interested in post-secondary education. Many prospective and current students, as well as others involved in a university, peruse the information provided on university websites for a variety of reasons. However, barriers exist when a person visits one of the web pages and cannot access the content due to a variety of reasons, including disabilities. The barriers can be impactful. According to the U.S. Department of Education (2019), "Nineteen percent of undergraduates in 2015-16 reported having a disability" (para. 1). The purpose of this study was to determine the level of accessibility of public university web pages as determined by Web Content Accessibility Guidelines (WCAG) 2.0 guidelines (Accessibility Guidelines Working Group, 2008). This study aimed to explore and describe the accessibility of public university college of education and teacher education program web pages in the state of Texas. The Web Content Accessibility (WCAG) 2.0 guidelines were used to frame the description since the universities are required to make reasonable accommodations to provide accessible content on the web pages.

Non-compliance with the guidelines may not only result in barriers for people with disabilities but also lead to investigations by the Office of Civil Rights (OCR). Literature, as well as the prevalence of colleges and universities under review by the OCR, indicate that many web-based university resources are not accessible (McKenzie, 2018). Investigations by the OCR can result in non-compliance issues findings that are costly and time-intensive to remedy. This chapter includes a summary of the significant

findings of this study as well as implications for practice, recommendations for research and a conclusion.

Findings from this study may provide information that university personnel can use to improve the web experience of people who visit any page of the university's website. The study specifically aimed to describe the accessibility of public university college of education and teacher education program web pages in the state of Texas by addressing these research questions:

1. How accessible are public university college of education and teacher education program web pages in the state of Texas as determined by WCAG 2.0 guidelines?
2. How readable are public university college of education and teacher education program web pages in the state of Texas?
3. Is there a difference in accessibility and readability between web pages of Texas public university colleges of education and their teacher education programs?

During the fall of 2019, the researcher evaluated representative pages from 26 public universities in Texas who had both a college of education and a teacher education program and whose enrollment ranked in the top 70%, based on the number of candidates who completed teacher education program requirements in 2017, to obtain information that may be used to answer the questions. Data were collected using the automated web accessibility and readability evaluation tools SortSite and Readable. The data included WCAG 2.0 recommended accessibility guideline success criteria and reading levels for each page. Data were then analyzed using SPSS to describe web accessibility and readability measures.

Summary of Findings

The first question centered on describing how accessible public university colleges of education and teacher education program web pages in the state of Texas are as determined by WCAG 2.0 guidelines. A few meaningful findings emerged from the data analysis. The first finding indicates that none of the web pages were designed in a manner that may cause seizures or reactions. Also, one guideline consistently failed, resulting in pages that are not robust or accessible by user agents and assistive technologies. For example, someone using screen reading software that converts screen text to speech may not be able to access the page content if it failed the guideline.

Additionally, low passing scores were also present on two WCAG 2.0 guidelines resulting in web page content that may present perception and operability barriers. For example, when a person zooms in on a page they cannot see the text or text links may not clearly indicate where the user will be directed if they select the link (Accessibility Guidelines Working Group, 2008). People visiting the pages may not be able to navigate to pages, via links, and obtain additional information. Successfully passing a guideline indicates that a page meets the success criteria that make it accessible for the specific guideline.

A paired-samples t-test was conducted to evaluate whether the four WCAG 2.0 principles pass rates were higher for the college of education web pages or teacher education web pages. The findings also indicated there was not a statistically significant difference in the WCAG 2.0 principles pass rates of the college of education and teacher education web pages. One possibility is that a standard web page template or developer accessibility evaluation process was implemented at the universities.

The second question centered on identifying how readable public university college of education and teacher web pages are in the state of Texas. Scans provided Flesch-Kinkaid grade level and rating data. Findings show the mean reading level of the college of education and teacher education pages was between 11th and 12th grade. Olney et al. (2017) report that most people are not reading at a nearly adequate level for success when first enrolling at a university. The data appears to provide support for further research about relationships between reading grade level and accessibility.

While attempting to answer the third question, information about differences in accessibility and reading levels was garnered from the data. Findings indicated there was not a statistically significant difference in the Flesch-Kincaid reading grade level or readability rating of the college of education and teacher education web pages. Additional findings indicated there is a weak relationship between college of education and teacher education grade levels and readability ratings.

Interpretation of Findings

Researchers have conducted numerous studies in the past ten years in an endeavor to obtain and contribute knowledge about web accessibility at institutes of higher education in the United States. While the researchers used different methodologies to conduct the studies, there are some notable similarities and differences in the studies worth interpreting that can aid in guiding future research. This study's purpose was to explore the accessibility of public university web pages in Texas, using WCAG 2.0 guidelines and automated website scanners. Forgione-Barkas (2012) also conducted a study about web accessibility compliance at institutions of higher education.

The two studies are similar in that both study samples consisted of web pages of institutions of higher education located in a single state, utilized the WCAG 2.0 guidelines to determine compliance and obtained data via an automated website evaluation tool. While the similarities are notable, the differences between the two studies, resulted in findings that can help illuminate the accessible state of post-secondary web pages. In addition to utilizing an automated scanner, Forgione-Barkas (2012) also used a rubric, completed by a web expert, and an interview. This study used an additional tool to obtain readability data from the sample websites. The study also only included selected college of education and teacher education web pages in the sample. While the instruments and samples differed, the results of both studies revealed information about accessibility compliance.

Both studies show that institutions of higher education websites in North Carolina and Texas are not in compliance with WCAG 2.0 standards. Forgione-Barkas (2012) indicates that, "Automated assessment results revealed that levels of page compliance varied from 96.2% to -612.7%" (p. 61). It appears that guideline 4.1 had a high failure rate for both studies. The rate suggests that the web pages present challenges to people attempting to view a web page with assistive technology and other user agents Both sites indicated there were compliance issues with WCAG 2.0 guideline 1.1, although they seemed to occur less frequently in this study.

Results of a study conducted by Freeman (2013) present similarities and differences to this study and provide additional data about the state of web accessibility at institutions of higher education in the United States. The similarities shared between the two studies are that both utilized the WCAG 2.0 guidelines to ascertain compliance and

the website samples consisted of institutions of higher education. Also, each study employed an automated website evaluation tool. Additionally, Freeman (2013, utilized a webmaster survey to obtain data while this study collected readability date with a scanner.

While this study focused on exploring the accessibility of public university's websites in Texas, Freeman (2019), centered the study on webmasters. Each study yielded data about website accessibility from additional different angles. The webmaster survey data provided information that could be analyzed to understand behaviors while the readability scan data provided data that may be used to describe a website's level of accessibility.

A comparison of the two studies ' findings shows that websites at institutions of higher education are not in compliance with WCAG 2.0. The study conducted by Freeman (2019) focused on webmasters and the intersection with website accessibility while this study's purpose was to explore and describe accessibility of sites that a webmaster, or developer, may have created. Comparing the results of studies with different purposes, yet centered on accessibility of institutions of higher education websites, provides knowledge and data that can be analyzed and used to formulate and conduct additional studies.

Implications for Practice

There are multiple potential implications for the data and findings generated by this study. College and university administrators can use the findings to create and revise existing web page policies to improve the accessibility of the sites. This may reduce reviews and revisions mandated by OCR and result in a considerable reduction of

financial and human resource expenditures by a university. According to Bias and Mayhew (2005), such things as improved access to healthcare and jobs provide enrichment for everyone when websites are accessible (p. 390). It will also allow administrators to reference the findings as they devise policies and web page remediation plans to address currently existing noncompliance with web content accessibility guidelines.

Another implication of the study is the potential use by web developers and designers to incorporate the findings in their practice. Understanding which guidelines more prevalently fail to meet accessibility guideline criteria, as well as the effect of readability measures on web pages, can be used during development to focus attention on potential issues. The findings can impact web designers and developers if instructional designers and trainers utilize them to modify the training that is offered to current and future web development personnel. They can modify the design and delivery of training to address issues that were identified in the study findings.

Additionally, another implication is to use the findings as a basis or catalyst for future research. The findings are based on data collected from public universities in the state of Texas that receive federal funding and are required under state statues to abide by WCAG 2.0. States that have similar requirements, or private institutions that seek to improve the accessibility of their web presence, may use the findings to conduct research relevant to the current structure of their given environment. They may also use the findings to focus research efforts on specific guidelines and principles.

Limitations and Recommendations

Using only one automated accessibility scanner to collect WCAG 2.0 guideline data instead of incorporating multiple evaluation methods may not have provided the researcher a broad or accurate data set. User testing, in conjunction with manual screening and automated scans, renders a broader representation of the accessibility state of web pages. Time constraints during the data collection timeframe resulted in only one evaluation method used by the researcher.

The readability scanner provided a reading score after rating the web pages. The ratings provide insight into the reading ease of web pages yet how the ratings are calculated is not published (Child, n.d.). Since the information about how the scores are derived is not available, there are limitations to interpreting the analysis of data gleaned from the scan.

Some recommendations are to conduct further research related to web accessibility in the private sector as well as research related to specific web accessibility guidelines or principles and readability measures. Often, when researchers conduct web accessibility studies, they collect data about each of the guidelines and principles spelled out in the different versions of WCAG. However, it may also be beneficial to conduct research about one guideline or principle and use multiple instruments to collect data about the one guideline or principle.

An additional recommendation is to use multiple means to evaluate the accessibility level of web pages. There are multiple tools and methods that designers and developers may use during the design and creation of new pages or ongoing revisions of existing web pages. Tools, such as automated electronic evaluation scanners provide

usable data (Masood Rana et. Al, 2011). Web page developers have a variety of evaluation options that may meet their situational needs. For example, expert analysis, in conjunction with an automated evaluation scan, may provide more holistic and usable feedback that can be used to improve the accessibility of a page.

Each method and tool has different strengths and benefits, and incorporating multiple evaluation methods can result in more accessible web pages. Selecting the combination of evaluation techniques that suit a given development environment and needs may be essential to maintaining a web presence that is accessible to all site visitors.

Conclusion

Overall, the college of education and teacher education web pages have similar accessibility levels. One guideline consistently failed, resulting in pages that are not robust, or accessible by user agents and assistive technologies. Learners using assistive technology, different browsers and mobile devices may not be able to understand, view or use the web pages. Another guideline, 2.3, designing pages in a manner that does not induce seizures, passed on all of the pages scanned. Additionally, low passing scores were also present on two WCAG 2.0 guidelines, resulting in web page content that may present perception and operability barriers to learners. There is an opportunity to improve web pages by revising elements on the pages and making the pages more perceivable, operable, usable and robust for all site visitors.

To support student learning and increase their opportunity for success, the web pages at universities will need to be accessible for all learners. Developers sometimes have intellectual disability awareness deficits and omit the needs of some learners when building web pages (Kennedy et al., 2011). Learners with intellectual disabilities, and

those with other types of disabilities can benefit when barriers to accessing learning resources are removed. Creating and updating web pages on a regular cadence, to improve their level of accessibility increases usability for all the page site visitors.

Additionally, public universities in the state of Texas are required to make reasonable accommodations to provide accessible content on the web, and non-compliance in investigations by the Office of Civil Rights. Identifying elements that fail accessibility scans provide information that designers and developers at universities can utilize to focus remediation efforts to bring their sites into compliance. Web development, training and university processes can be revised and updated to ensure future iterations of pages are accessible.

Findings from this study provide information that university personnel can use to improve the web experience for individuals that visit their sites. Additionally, they can use the information to address policies and processes specific to web page non-compliance issues that cause learning information access barriers for students. Further research, based on the findings of this study and specific to different university populations, can yield results that university personnel may use to improve student web information access further. Revising policies and processes at universities can result in improving the accessibility level of public university web pages and increase opportunities for student success as they access information on university web sites related to their interests and studies.

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Appendix A

Guideline Variables

Variable Name	WCAG 2.0 Guideline
GL1.1	Guideline 1.1 Text Alternatives
GL1.2	Guideline 1.2 Time-based Media
GL1.3	Guideline 1.3 Adaptable
GL1.4	Guideline 1.4 Distinguishable
GL2.1	Guideline 2.1 Keyboard Accessible
GL2.2	Guideline 2.2 Enough Time
GL2.3	Guideline 2.3 Seizures
GL2.4	Guideline 2.4 Navigable
GL3.1	Guideline 3.1 Readable
GL3.2	Guideline 3.2 Predictable
GL3.3	Guideline 3.3 Input Assistance
GL4.1	Guideline 4.1 Compatible