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Web Content Management System and accessibility awareness: A comparative study of novice users and accessibility outcomes

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Web Content Management System and Accessibility Awareness: A Comparative Study of Novice Users and Accessibility Outcomes

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by

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USE OF THESIS

ABSTRACT

Since its creation, the Web has progressively developed and become a vital source of information in every domain and for almost all people. It is crucial to guarantee that the information contained on the Web is available for everyone, especially for people with special needs. Removing accessibility barriers is fundamentally based on tools, skills and support of all contributors, particularly the content creators, to ensure information is navigable and usable in the context of the end users experience. Web Content Management Systems play a significant role in structuring, storing and provision content to the Web and have evolved to address the difficulties of manually coding web pages versus the convenience of manipulating their content without any programing skills. Web Content Management Systems have gradually evolved to contain features and functions that allow content authors to shape their content in ways that address web content accessibility expectations, though only if the content author knows how to use these features to maximum effect. This thesis explores such usage by participants deemed to be novices, in that they have limited technical skills in the context of web coding and have limited expose to Web Content Management Systems or the application/awareness of the Web Content Accessibility Guidelines (WCAG). This research places an emphasis on the outcome of these novice users when provided with some basic training and awareness raising of WCAG principles and the use of a modern Web Content Management System. This is explored in the literature as an area of some importance as organisations with significant web presence cannot simply tell their content authors to ‘oh, and make sure it is accessible’ and hope that the end product will somehow achieve that goal without an investment in some form of accessibility education.

> For web managers and developers in all public sector organisations. “Make sure that all content commissioners and authors are fully trained in the importance of accessible content, and in the means that are made available for them to achieve this. (p. 58)

The purpose of this research was to explore to what level the use of accessible Web Content Management System and novice users’ training impacted accessibility outcomes. This study emerged from the widespread role that Web Content Management Systems play in terms of storing and managing web content and the growing usage of these systems by experts or novices at an organisational or personal level. Through a selection process, this study identified a Web Content Management System that had a number of accessibility features, developed some training and 'awareness raising' materials and then asked novice users across two groups to apply what they had learned in order to develop an accessible website. The goal of the study was to ascertain if the two groups performed differently according to the training and awareness raising materials they received, and if even basic accessibility outcomes were achievable with just a few hours of training and from what was essentially an accessibility 'cold start'.

The study used a mixed methods approach encompassing three research methods; experimental method, survey method and observational method, to compare qualitative and quantitative data obtained from 'accessibility awareness' and 'accessibility unaware' participant groups. Thirty university students participated in this research and received accessibility awareness raising sessions, with additional accessibility-related examples for the accessibility awareness group. All participants undertook pre and post-tests that were designed to collect data allowing the researcher to compare the learning performance before and after the participants' awareness session. At the end of the awareness session, the participants of both groups completed a survey which was designed to provide further data on the participant's perception of web use and experience, the concept of web accessibility, web content accessibility guidelines, the system used, and their opinion of the accessibility awareness session. Data collected from the survey, pre and post-tests and the recording provided a holistic set of data from which the primary and supporting research questions were addressed.

The results of the research indicated that the accessibility awareness group demonstrated measurably better accessibility outcomes than the unawareness group; these results being attributed to the awareness training session, participants' searching behaviour, time spent on tasks, and effort made to implement accessible features and complete the required tasks. The participants in both groups had some prior knowledge in the use of the Web but limited or no skills in HyperText Markup Language (HTML) or the use of a Web Content Management System. While performing tasks, the participants in the awareness group attempted to apply the accessibility concepts learnt during the training session and spent more time in searching those concepts on the Web in order to provide accessible

web page content. Conversely, most of the participants in the unawareness group were concerned by the "look" of the web page, rather than focusing on actual accessible content; they only mimicked the exemplar website they have been provided as an 'end product', but did not explore the how and why of accessible content. All the participants at the end of this study were aware of the significance of web accessibility and were favourable to consider it in any future website development they may be involved in.

The outcome of the study shows that the use of accessible Web Content Management System with example-based accessibility awareness sessions can lead to improved accessibility outcomes for novice web content authors. This research strongly suggests that even small, focussed and example-based training/awareness raising session can drive an accessibility mindset in web content authors, even those with limited or no technical, accessibility or web authoring experience.

DECLARATION

I certify that the thesis does not, to the best of my knowledge and belief:

(i) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher degree;

(ii) contain any material previously published or written by another person except where due reference is made in the text; or

(iii) contain any defamatory material.

Signed______[redacted]______________________________

Date: 17 December 2019

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Many thanks to all the participants from Edith Cowan University, whose cooperation was the most valuable support for this thesis.

DEDICATION

I dedicate this thesis to my son Adam for his strong support, profound love and continual sacrifice all along this trajectory. No words or expressions could describe my intense feeling and my appreciation for what he endured to realise my dream; I will never forget his advice with "Never give up", especially during our tough moments.

To my mom, my love and esteem never end; the rest of my family, especially the beloved ones, many thanks for the continual support.

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Thanks to all my friends.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AAG	Awareness accessibility group
ABS	Australian Bureau of Statistics
API	Application programming interface
ARIA	Accessible Rich Internet Applications
ATAG	Authoring Tool Accessibility Guidelines
AUG	Accessibility unawareness group
CMS	Content management system
CSS	Cascading Style Sheet
DDA	Disability Discrimination Act
ECU	Edith Cowan University
HCI	Human–computer interaction
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
IEC	International Electrotechnical Commission
IQR	Interquartile range
ISO	International Organization for Standardization
MCQ	Multiple-choice question
MIT	Massachusetts Institute of Technology
PHP	Hypertext Pre-processor
RSS	Rich Site Summary
UAAG	User Agent Accessibility Guidelines
URI	Uniform resource identifier
URL	Uniform resource locator
W3C	World Wide Web Consortium
WAI	Web Accessibility Initiative
WCAG	Web Content Accessibility Guidelines
WHO	World Health Organization
WWW	World Wide Web
WYSIWYG	What You See Is What You Get
XHTML	eXtensible Hyper Text Markup Language
XML	Extensible Markup Language

CHAPTER 1: INTRODUCTION

1.1 Introduction to the Study

The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect.

—Tim Berners-Lee, W3C director and founder of the World Wide Web

(W3C, 2015b, para. 1)

The evolution of the World Wide Web (WWW) over the past three decades has seen it become the definitive communication and information sharing platform for a majority of the planet's population. Web users have evolved from simple consumers to valuable contributors through systems that allow the rapid development and publication of single web pages to entire websites. Nevertheless, the rapid growth of the web as a unique information platform has given rise to various problems, including inequality in the use and accessibility of web content (Ekstrand, 2017; Ellis & Goggin, 2015; Feingold, 2017).

The World Health Organization (WHO) claims that approximately 15% of the world's population has some form of disability (WHO, 2019a, para. 1), indicating that of the reported 4.4 billion current web users, approximately 650 million have special access needs (Statista, 2019a). In a 2015 survey of disability, ageing and carers in Australia, 4.3 million individuals (representing roughly 18.3% of the population) identified as having a disability (Australian Bureau of Statistics [ABS], 2018). The survey also revealed that more than half (53%) of respondents with disabilities accessed the web regularly in 2009 and up to a third (34%) used it for trade or employment purposes (ABS, 2014). These statistics show that people with special needs use the web as a vital communication and productivity tool and that barriers to accessing and using the web may have a significant impact on their lives.

Accessibility is related to reducing or eliminating barriers and allowing people with special needs to use the web as readily as those without special needs (W3C, 2005). Assistive technologies, such as screen readers for people with visual disabilities, have contributed to improved access to the web (Berry & Ignash, 2003); however, the effective use of these technologies requires sites to be designed correctly. Laws and policies (Australian Human Rights Commission, 2013; Depatrtment of Finance, 2014; Tyler, 1993) provide recommendations for governments, corporations and organisations to use best practice to produce accessible websites. Guidelines have been developed over the last two to three decades to address issues related to web accessibility and to improve the accessibility of content, media and authoring tools. The three most prominent sets of accessibility guidelines are the Web Content Accessibility Guidelines (WCAG) 1.0 (W3C, 1999b), WCAG 2.0 (W3C, 2018d), the User Agent Accessibility Guidelines (UAAG) (W3C, 2012c) and the Authoring Tools Accessibility Guidelines (ATAG) (W3C, 2013b).

The guideline of interest in this thesis is WCAG 2.0 (the standard guideline at the time of writing). WCAG 2.0 is an internationally recognised set of standards (International Organization for Standardization/International Electrotechnical Commission [ISO/IEC] 40500) for creating accessible websites and web content across three conformance levels: A, AA and AAA. While AAA is considered to be the gold standard for accessibility (for accessibility-specific audiences), most organisations aim to conform to Level AA. ATAG is a set of guidelines coupled to WCAG 2.0 that promotes the accessibility of developer tools (used in web and application development) for people with disabilities as well as the development of web systems and content that are compliant with WCAG 2.0 (Iglesias, Moreno, Martínez, & Calvo, 2014).

Although this thesis refers to ATAG only briefly, it was initially viewed as a core component in this research as a guide for identifying a web content management system (CMS) within which the practical aspects of this research would take place. Theoretically, an ATAG-compliant web CMS environment should readily support the creation of accessible web content through its interface and content authoring features. Given that ATAG was a newly developed standard and had not been widely adopted by the developer community at the start of this research, the selection of a web CMS tool was derived from a series of test cases conducted by the researcher on a selection of contemporary systems available at the time.

Web CMSs are a core focus of this research because they have a large user base (both individual and organisational) worldwide and are designed to allow novice users with no in-depth knowledge of Hypertext Markup Language (HTML), to create content. Although their evolution and usage tends to fluctuate, WordPress, Joomla and Drupal were among the most widely used web CMS tools at the time of writing (W3Techs, 2015a). The uptake of these tools appears to be driven by their ease of use for the publication of web content by non-experts who are not fluent in HTML and related web technologies (J. M. L. A. Pascual, Menduiña, & Granollers, 2012).

The final and most crucial component of this research is that of accessibility awareness and the effect it has on how individuals use authoring tools such as web CMSs in a way that allows all users to find and consume web content. The thesis explores the level of translation of accessibility guidelines required—through training and exemplars—for novice content publishers to produce accessible output. This research explores the awareness-raising process and applies the concept of web accessibility to a web CMS environment for participants who use the web but who are not web developers.

1.2 Statement of the Problem

Some research problems arise from the lived experience of researchers and the complexities of their work environments, while others are derived from perceived gaps in the academic literature and area of expertise. In this study, the researcher had previously undertaken an honours thesis that explored the barriers that people with special needs encounter when managing a web CMS rather than when using the end product.

From this work, the question arose as to what built-in accessibility features were present in modern web CMS tools and if, by default, the use of these features created a more accessible end product. Given that web CMS tools are highly prevalent in educational, corporate and government settings and that some of these tools allow for the creation of accessible content, why are mainstream websites still languishing in terms of accessibility compliance? (M.-l. Leitner, Strauss, & Stummer, 2016; Vázquez & Bolfing, 2013). The core problem was to determine how accessible web content can be created using web CMSs by content authors who understand only the basic principles of accessibility, as opposed to a scenario in which more in-depth, example-based aspects of accessibility are covered. Would the built-in accessibility features such as text and link descriptor fields in a contemporary web CMS provoke equally accessible outcomes from users with various levels of accessibility awareness training? Or would both the features of the web CMS and the depth of the awareness-raising materials be key components in achieving accessibility outcomes? Figure 1.1 below illustrates examples of accessibility features captured from the Blackboard learning management system in which options for alternative (alt) text, long descriptions and link titles may be entered by the content author. Completion of these fields is not mandatory and, aside from the 'Name of Link to File' field in which an explanation of the alt text is provided, no such explanation exists in other cases. Later chapters will discuss the full set of accessibility features explored in this research through the selected web CMS. However, Figure 1.1 provides a useful snapshot of the types of accessibility features that were used by participants in this study and the awareness-raising materials that preceded their content development efforts.

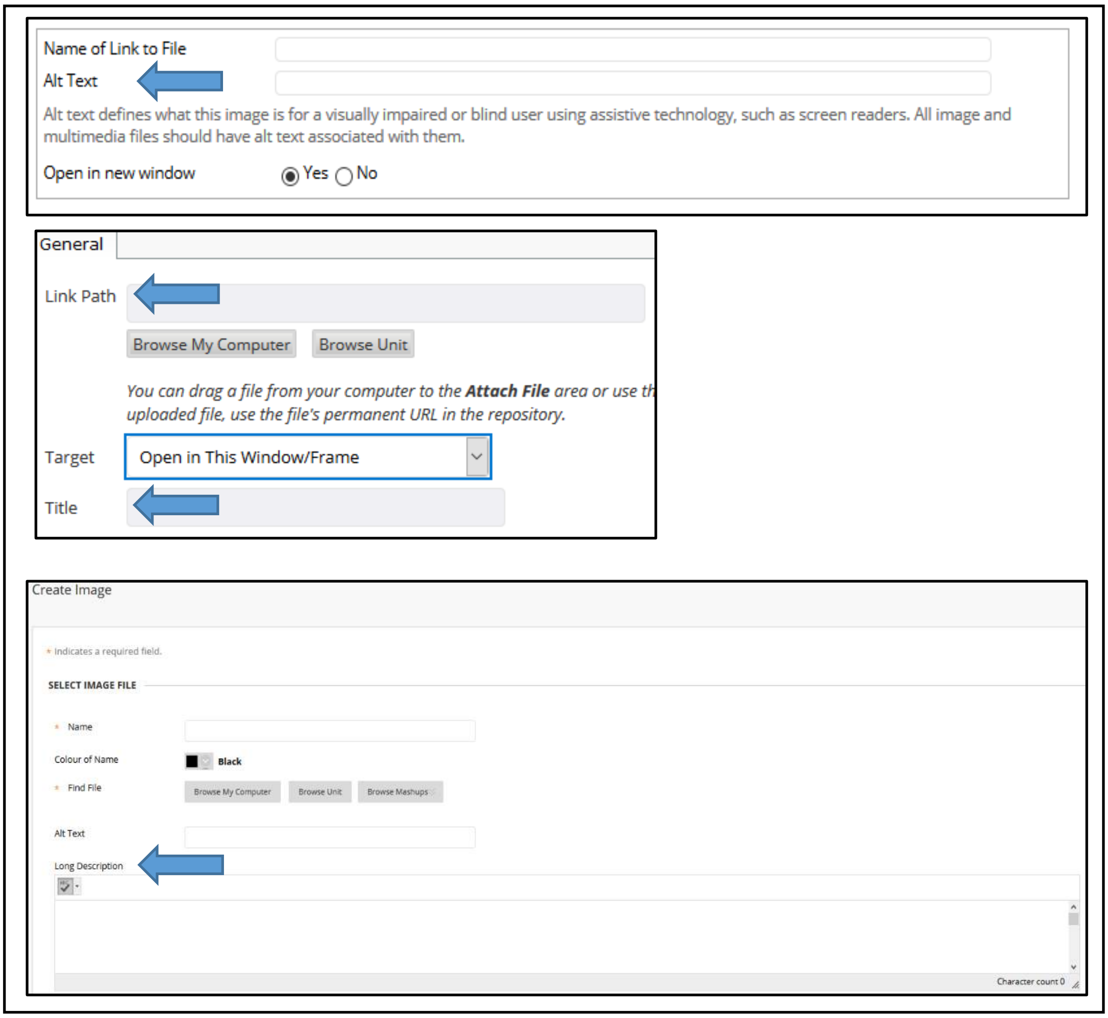


Figure 1.1: Example of accessibility features similar to those used in this research

(Screenshot taken from Edith Cowan University instance of Blackboard 9.1)

Given that modern web CMS tools have a large user base and that many countries, states and organisations have documented accessibility goals (typically WCAG 2.0 AA), how can accessibility outcomes be improved? Can content authors be shown how to use web CMS tools to provide accessible content, and if so, how much time and effort is required? Does the use of an accessible web CMS combined with concise awareness-raising materials improve accessibility or is the incoming technical expertise of the content author a defining aspect of how accessibility is learned and applied? These are the core problems that evolved during the development and execution of this research and that are explored in the literature, methodology, analysis and findings.

1.3 Background to the Study

The increasing use of web CMSs worldwide and their role in developing and managing web content by users of varying technical capabilities has motivated this work.

Broadly, CMSs (web-based or not) are used by institutions and governments to create, store, manage and publish corporate data internally or via the web. The benefit of CMS tools, web CMS tools in particular, is that the majority of users do not necessarily need to be technically oriented (Harney, 2009). For example, a large organisation may have a web CMS tool that allows staff in various departments to add text, images, links and files to content pages for their department while never writing a line of HTML code. These individuals may, for the most part, interact with web-based forms and control panels that allow them to complete their tasks in a way that does not affect underlying web CMS operations or the rendering of the resulting HTML page. Hence, an individual may be considered an expert in using a web CMS tool as an end user but have little or no knowledge of HTML-related technologies. Figure 1.2 below provides an example of a content authoring interface in the Drupal web CMS in which a user can create an online story and send it for editing or publication, even though there are no options for the user to edit HTML or presentational elements.

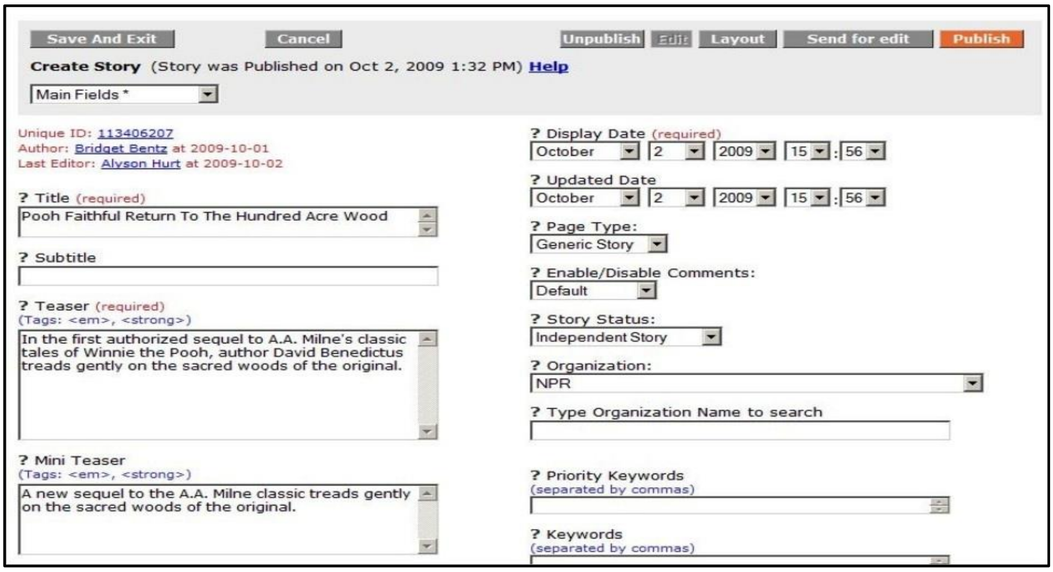


Figure 1.2: Example of web content management system user interface

(Leers, 2013, 31 May)

Users of such systems—those with the ability to use web-based tools but without expertise in underlying web technologies—may be defined as novice users. In the scope of this research, a novice user is considered a user of web systems who sits on a scale between consumers of web services or systems and experts or developers of web services and systems (see Figure 1.3)

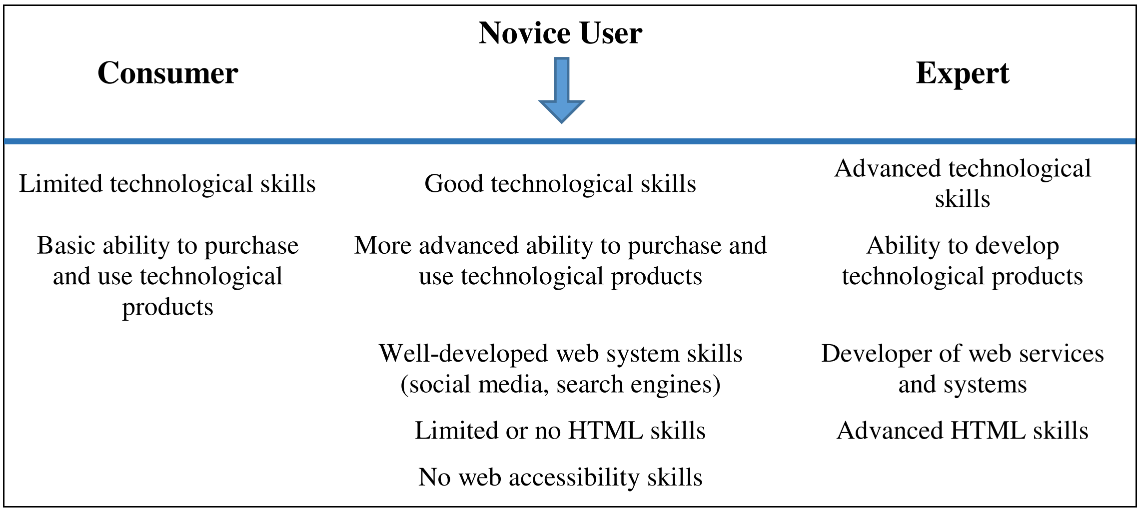


Figure 1.3: Novice user on the technology expertise scale

Given the prevalence of web CMS tools for the management of some of the web's most popular sites (Schäferhoff, 2018) and the ever-present drive for websites to be more accessible for a diverse population of users, work is needed in this area.

As the literature review shows, there are several studies that have evaluated the accessibility of web CMSs, their interfaces and content output. However, there appears to be an identifiable gap in how systems with built-in accessibility features used alongside awareness session training influences accessibility outcomes for novice users.

1.4 Purpose and Rationale for the Study

The primary purpose of this study is to investigate the effect of accessibility awareness on novice users using CMSs that include features to create accessible content. It also aims to create evidence-driven results for whether provision of accessibility awareness training provides meaningful returns and the role it plays in such outcomes. Bruce and Beverly (1980) state that training can result in several outcomes, beginning with awareness of the learning area. From here, individuals may build their knowledge and acquire fundamental skills that can then be applied:

> Whether we teach ourselves or whether we learn from a training agent, the outcomes of training can be classified into several levels of impact: awareness; the acquisition of concepts or organizational knowledge; the learning of principles and skills; and the ability to apply those principles and skills in problem-solving activities. (p. 2)

The process of this research aligns with Bruce and Beverley's statement—the effect of selective training is measured in terms of its ability to raise awareness and improve capabilities in the area of web accessibility for participants with little or no existing knowledge of the subject. This awareness may improve knowledge and reinforce skills, which may be used as tools of action to improve accessibility or at least to build some level of knowledge that may be useful in the future.

Despite the increasing body of literature focused on the importance of web accessibility and CMSs for web content providers, more research is required on awareness of accessibility and how it relates to the creation of accessible content using web CMSs. This research aims to address this gap and to contribute to the literature to provide contextual information for future works. It is also predicted that the findings of this study will provide guidance to organisations that invest in humans and tools. The rationale for this study is to explore whether a combination of the right web CMS with the right learning materials can assist novice users to learn and apply skills in a short period to significantly improve accessibility of web content.

1.5 Definition of Terms

In the field of web accessibility research, a plethora of terms are used, with some being common and others potentially confusing. To enhance understanding of the terminology used in this thesis, relevant definitions are provided in the following list:

- Accessibility (specifically web accessibility): equal access to the use, navigation and interaction of the web for people with a broad range of disabilities (W3C, 2005)
- Assistive technology: software or hardware designed to support people with disabilities in their daily activities (Baguma & Lubega, 2008)
- Authoring tools: services and software used by authors (web developers, designers, writers, etc.) to create or modify web content. Common examples of these tools include web CMSs, code editors, wikis, blogs and social media (Abou-Zahra, Brewer, & Henry, 2013; W3C, 2015c)
- ATAG: accessibility guidelines established by the World Wide Web Consortium (W3C) to help developers produce accessible authoring tools aimed at the creation of accessible content by and for disabled people (W3C, 2013b)
- Novice user: an individual with some computing skills but little to no knowledge of web accessibility or HTML
- W3C: an international group in which member organisations work together to develop web standards and ensure the power and continuity of the web (W3C, 2015a)
- WCAG: standards developed internationally with the cooperation of W3C that provide common guidelines for web content (W3C, 2013e)
- Web content management systems (web CMSs): systems used to manage the content and functionality of a website
- Web page: a document written in HTML accessible via the internet or other network using a web browser or other user agents
- Website: a collection of one or more interlinked web page(s) (W3C, 1999a)

- WWW (also referred to as 'the web'): a graphical interface for the internet that supports web pages linked to each other and other documents and files, including audio, video and graphics.

1.6 Statement of Research Questions

The primary purpose of this research was to investigate the effects on novice users of accessibility awareness when used in conjunction with a web CMS that provides support for the creation of accessible content. Three research questions were established to provide input to the main research question:

> *Can the use of web CMSs with accessibility features lead to improved accessibility outcomes for novices?*

From this main research question, three supporting questions were defined to help address the specified problem. The use of a compliant web CMS should lead to compliance. However, when these tools are used by novices, the results may or may not align with this assumption. In this regard, the supporting questions assist in providing adequate information for this research.

1.6.1 Supporting Question 1

The first supporting question was designed to address the core aspect of this research by providing quantifiable data on how the awareness session influenced the performance of participants.

> *What role does accessibility awareness play in the successful completion of tasks related to creating accessible web page content?*

This research question intends to examine whether awareness about accessibility influences the completion of tasks by participants and which aspects contribute to the outcomes for both groups—accessibility awareness group (AAG) and the accessibility unawareness group (AUG)—in terms of task completion. Knowledge of HTML and accessibility was examined for improvement following the awareness session, with the aim of providing evidence on the role of improved knowledge on task completion. Awareness of accessibility and HTML skills (whether it existed prior to or was acquired during the awareness session) was observed during task performance and in the implementation of accessible features to gather conclusions about its effect on the completion of tasks. Little research has been done on the effects of accessibility awareness on task completion or outcomes in general, a gap that this research aims to address.

1.6.2 Supporting Question 2

The second supporting question was aimed at examining whether use of a web CMS environment could deliver accessibility outcomes:

> *What role did the usage behaviour of the web CMS environment play in participants' accessibility outcomes?*

This question focuses first on the features of the system itself and whether they facilitate accessibility when used effectively by participants and, second, on participants' usage behaviours. WordPress is a user-friendly system for both users and publishers that incorporates numerous features and functionalities via its multiple plug-ins. Some of these features reside in its ability to offer tools and functionalities, making it one of the most commonly used worldwide. It is recognised for its simplicity of use, its flexibility in creating and managing any type of website and the ability to manipulate content, insert pictures or media and publish online (WordPress, n.d-a).

Even with WordPress' various functionalities and options, aiming to reduce some load such as HTML, CSS, PHP, and so forth, users of the system need to have necessary coding skills. WordPress has made it possible to build a website without being technically-savvy users; however, novices should acquire some level of knowledge in HTML to perform tasks. At some point, they need to edit the content of their websites in order to enhance some features that require HTML codes or add new functions or customise the website style by using CSS or even understand and solve potential problems.

> As regards WordPress, there are two good reasons for learning website programming languages, namely, the ability to better modify appearance/content and to become more efficient at troubleshooting any issues.
>
> Modifying a WordPress website could be as simple as tweaking colors or font sizes in a theme, or as major as creating an entire WordPress theme from scratch. As for troubleshooting, an understanding of the core programming language makes it

> much easier to ascertain why and where a problem has occurred. The first, and easiest, web programming language to learn is HTML (Affiliate Marketer Training, n.d.para. 3).

The thought of basic HTML knowledge to perform tasks while using WordPress, in which most requirements for novice users are present, is crucial to provide well-structured content. Learning elementary HTML coding allows users to create consistent content for the entire website and ensure the reliability across different implements (screen readers, browsers and search engines) and also control the entire website's presentation through the integrated CSS in the CMS or handle the presentation via the text editor to make it compliant with the web standards.

For this study, the most important of the WordPress features is its full standards compliance:

> Every piece of WordPress generated code is in full compliance with the standards set by the W3C. This means that your website will work in today's browser, while maintaining forward compatibility with the next generation of browser. Your website is a beautiful thing, now and in the future. (WordPress, n.d-a, para. 9)

WordPress is recognised as a largely compliant to WCAG 2.0 guidelines and user-friendly platform with built-in accessibility and various functions for building an accessible website, although other influential factors are likely to exist.

The usage behaviour of the system is the most important consideration. WordPress offers most of the critical features required for providing accessible content and, where it lacks these features, it allows the addition of codes via the editor—hence, outputs should be accessible. However, the use of the system on its own may not be sufficient if its usage is ineffective. Can novice users with limited or no skills and experience use and provide accessible outcomes? How effective is their interaction with the system? Do they benefit from awareness training and put their new skills into practice? If so, what is the outcome? Moreover, what is the difference between the AAG and AUG in terms of usage behaviours and outputs? These questions informed the investigation of these effects to address this supporting question.

1.6.3 Supporting Question 3

The final supporting question of this research seeks to investigate the effects of task complexity on participant behaviour and task achievement:

> *What role does task complexity play in participants' behaviour and task completion in relation to the production of accessible content?*

This question examines the behaviour of participants when completing complex tasks and the role of complexity in completing required tasks. Complexity is based on the difficulty perceived by participants when performing required tasks, the amount of the time spent on tasks, the knowledge and skills needed to seek information and the techniques used to find information and adapt it to their situation. P. Liu and Li (2012) report:

> It is commonly believed that human performance depends on the interaction among task characteristics (e.g., complexity and urgency), task performer characteristics (e.g., knowledge and skill) and environment characteristics (e.g., noise and temperature). Task characteristics are expected to have significant influences upon individual and group behaviors. (P. Liu & Li, 2012, p. 1)

Apart from the environment aspect, this statement aligns with the intent of this question in that participants' performance may depend on their skills and knowledge, complexity of tasks, the limited time provided to complete tasks and the significant impact of task characteristics. Moreover, to expand the investigation, time taken and efforts made were considered to detect the relationship between these elements and task completion.

1.7 Significance of the Study

This research is significant because it examines the effects of short-term accessibility awareness training used alongside a web CMS with built-in accessibility features on accessibility outcomes. Results were derived from the efforts made, the ability to complete tasks and implement accessibility features, and improvements in performance and knowledge of HTML and accessibility following the awareness session.

The significance of the research will be in the potential provision of a model for web CMS adoption in a world where accessibility should be a standard feature but frequently is not. Being the ultimate decision-makers in acquiring web CMSs for website management and content control, government agencies and corporations should provide compliant systems to assist their employees in the creation of accessible content and offer training sessions to improve employee skills. This study aims to provide evidence for whether the correct use of a web CMS with built-in accessibility features accompanied by appropriate accessibility awareness training leads to the creation of accessible content.

1.8 Organisation of the Thesis

This thesis is structured into six chapters, showing the overall work performed. Chapters are organised as follows:

Chapter 1 provides the research framework and presents the elements that explain the significance of the current study and its contribution to the literature. Further, it includes the statement and the background of the study, a brief definition of terms used, how the three research questions support the overarching research question and the structure of the research.

Chapter 2 provides a brief history of the web and an overview of the relevant literature related to accessibility concepts, which includes guidelines, laws, conflicts, technologies, issues and training. Web CMSs are discussed with respect to their role and compliance with accessibility guidelines, which have been largely disregarded by the web community. The chapter explores issues of accessibility and the prospective education of contributors on the importance of awareness and training in developing accessible content that will benefit all internet users.

Chapter 3 describes the methodology adopted and the various methods and tests used in the research. It outlines the overall design, instruments used (pre-test, post-test and survey), phases of the study and ethics considerations.

Chapter 4 presents the results of the research, which were collected by questionnaires and recordings of participants while working on the tasks. These results provide a baseline for the analysis phase.

Chapter 5 provides an analysis of the data collected and answers the research questions.

Chapter 6 provides the main findings of the research that underpin the answers to the supportive and primary questions of this study. It summarises the issues, offers recommendations for future works and finishes with concluding remarks.

CHAPTER 2: LITERATURE REVIEW

The body of literature on accessibility area is abundant and broad. Chapter 2 presents a review of accessibility and its concepts in diverse contexts, including technologies, guidelines, content, policies, tools and awareness, with an emphasis on aspects that are particularly relevant to this study. The chapter also discusses the evolution of the web as a space in which information is created, stored, published and used by all. To this end, accessibility and the tenets contributing to its implementation are examined in the first sections of this chapter, progressively moving to the levels of the awareness and action regarding disability.

2.1 Brief History and Growth of the Web

The web has its roots in a number of conceptual and technological developments going as far back as the mid-1940s, from Vannevar Bush's Memex (Filman, 2005; Houston & Harmon, 2007; Rajaraman & Bush, 2000; Veith, 2006; Yeo, 2007) to Ted Nelson and Andy Van Dam's HyperText editing system and Douglass Engelbart's oN-Line system in the 1960s (Simpson, Renear, Mylonas, & van Dam, 1996; van Dam, 1988) to Tim Berners-Lee's breakthrough work in 1989 (Strawn, 2014).

Since then, the web has undergone a phenomenal growth in size (Bratt, 2010) and reach to become the preeminent information storage and retrieval system worldwide (Ingram, 1995; Lawrence & Giles, 1998). Part of Berners-Lee's vision for the web, which he was responsible for creating, was the evolution of what he described as the 'semantic web' (Lamandini, 2011; Shadbolt, Hall, & Berners-Lee, 2006), one that was equally accessible to all people, regardless of race, colour, gender, religion or physical abilities, to collaborate, communicate and express creativity (Abou-Zahra et al., 2013). Within five years of the WWW making its appearance, the issue of web accessibility arose:

> What began as primarily a text and number-based medium has evolved into one laden with detailed graphics, animated pictures, and complex page layouts. Although this evolution has proved a great benefit for the average user, it has created difficulties for people with disabilities. (Carter & Markel, 2001, p. 1)

Despite decades of research, a global and inclusive vision of the web continues to be debated to address accessibility issues and develop the potential of the web for better inclusion and understanding via tools, guidelines, policies and the continual work of communities worldwide.

2.2 World Wide Web Consortium

In 1994, Tim Berners-Lee founded W3C at the Massachusetts Institute of Technology (W3C, 2015f). W3C comprises more than 450 international members, almost 70 full-time staff and various community organisations (W3C, 2003) and aims to develop and improve standards that drive web technologies (W3C, 2015d).

W3C's (2003) mission is to provide a vision and to create standards to promote, improve and contribute to the evolution of the web:

> World Wide Web Consortium (W3C) creates Web standards. W3C's mission is to lead the Web to its full potential, which it does by developing technologies (specifications, guidelines, software, and tools) that will create a forum for information, commerce, inspiration, independent thought, and collective understanding. (para. 1)

The three crucial principles in W3C's mission are based on open standards, design and vision. The first principle relates to the agreement between W3C and other prominent organisations to adhere and contribute to standardising web technologies by supporting The Modern Paradigm for Standards (W3C, 2015g). Standards should be designed to enable cooperation between standards organisations, adherence to development principles, shared consent in standards confirmation, availability and voluntary acceptance (Open Stand, n.d).

The second principle relates to the design of existing and future web technologies. To realise the idea of a 'web for all' and a 'web on everything', consideration of the social value of the web and its contribution to communication and knowledge sharing is imperative. The Web Accessibility Initiative (WAI), internationalisation and the Mobile Web for Social Development, along with other devices and browsers used to access the web, will help to achieve this principle (W3C, 2015g).

The third principle involves W3C's vision for the future of the WWW. The committed involvement of and contributions from the web community are essential. Valuable components of this principle include the use of the web for rich interaction, message exchange and trust (W3C, 2015g).

Many of the standards used in this study have been developed by various W3C working groups over the last two decades. This includes the primary accessibility standard—WCAG 2.0—released by W3C in 2008 after years of development and subsequently released as an ISO standard in 2012. The development of a new W3C technology standard can take many years because of the high level of consultation needed between private, community and commercial members of the organisation, with numerous iterations being required before a technology standard is established (Acebal, Bos, Rodríguez, & Cueva, 2012).

In most cases, private and commercial developers will begin to adopt key aspects of evolving technologies prior to the finalisation of a standard, as occurred in the case of HTML5, which officially became a W3C recommendation in October 2014, despite textbooks for HTML5 bring available since at least 2010. Some standards, such as WCAG 2.1, do not feature in this study because were only being released at the time of writing, with the publication of the first version being in 2018. However, available standards implement many features of the new recommendations for providing accessible content.

2.3 Web Accessibility

This section focuses on reviewing the literature related to accessibility perceptions, issues and training to achieve the aim of global access.

2.3.1 Accessibility Perceptions

Notions about the meaning of accessibility are conflicting (Yesilada, Brajnik, Vigo, & Harper, 2012) and there is a lack of general agreement about its definition (Persson, Ahman, Yngling, & Gulliksen, 2015). Since the web has become a significant concern, views on accessibility are divergent. Equality of access for all users is the most common definition of accessibility (Brajnik, 2011; Grantham, Grantham, & Powers, 2012; Henry, Abou-Zahra, & Brewer, 2014; Hull, 2004; W3C, 2005; Yesilada et al., 2012). This vision appears to be human centred, focusing on the accessibility needs of individuals rather than on technical specifications. Nevertheless, other definitions in the literature from different perspectives strengthen the meaning of accessibility for both those involved in the web accessibility community and those who are not (Yesilada et al., 2012).

In 2012, Yesilada et al. (2012) conducted a survey to explore the understanding of web accessibility from the point of view of web accessibility experts (n = 100) and non-experts (n = 200). This study identified five common definitions of web accessibility (see Table 1.1), representing technical and social orientations from a wide range of reliable resources. The W3C definition of accessibility (denoted by D1 in Table 2.1) was the most preferred among respondents, regardless of age, profession, education level or country. However, this definition appears to be exclusive as it refers only to people with disabilities (referred to as 'people with special needs' in this thesis) and excludes other web users, which contrasts with its concept of 'web for all' (W3C, 2015g, para. 3). Other definitions (D2, D4, D5 and D3) were also considered by respondents in terms of their clarity, simplicity, effectiveness, efficiency and acceptance but were criticised for their exclusivities, ambiguities or inaccuracies. This study claims that people are driven by social rather than legal or financial factors, even with existing efforts to promote these aspects. It also shows that accessibility remains a concern because it is not a prerequisite for website designers.

Table 2.1: Definitions of web accessibility

D1	Web accessibility means that people with disabilities can use the web. More specifically, web accessibility means that people with disabilities can perceive, understand, navigate and interact with the web, and can contribute to the web.
D2	Technology is accessible if it can be used as effectively by people with disabilities as by those without.
D3	The extent to which a product website can be used by specified users with specified disabilities to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.
D4	A website is accessible if it is effective, efficient and satisfactory for more people in more situations.
D5	The removal of all technical barriers to effective interaction.

Source: Yesilada, Brajnik, Vigo and Harper (2012, p. 2)

Other definitions of web accessibility are different from traditional concepts, which restrict the definition of accessibility to people only, especially those with special needs. Some state that accessibility can be achieved through a user-centred design process (Yesilada, Vigo, Harper, & Brajnik, 2015). Tasks such as accessibility testing, source code checking and training in WCAG should be undertaken during the design process. Given the conflicting opinions and acceptance of this method in terms of its improved accessibility outcomes, the undertaking and evaluation of this approach is complex. Some authors have also suggested that the concepts of 'design for all, universal design, inclusive design, and universal access' (Persson et al., 2015) may be used in different contexts and for various purposes. However, these approaches may be costly because they require involvement, continual updates and analysis of the needs of governments, corporations and all users.

Some authors highlight that there is a relationship between accessibility and usability. In their study, Petrie and Kheir (2007) confirmed that usability and accessibility problems may be perceived as 'pure accessibility problems', 'pure usability problems' or 'universal usability problems', implying that accessibility and usability have different sets of problems. However, these problems may affect both people with or without disabilities (Petrie & Kheir, 2007). They also report that the two concepts are complementary because they aim to facilitate access and use for every user. Although some aspects of this relationship have been discussed, there is still a lack of understanding. Casare, Silva, Martins, and Moraes (2016) debated this complementarity in their work while mapping the principles and guidelines of WCAG 2.0 to Nielsen's heuristics in the field of human–computer interaction (HCI). According to Fortes, Antonelli, and Salgado (2016) , the heuristic method 'involves inspectors' judgment about the conformance between the evaluated interface elements and a pre-defined set of broad usability principles' (p.7). The work of Casare et al. indicated that either accessibility guidelines or heuristics can capture issues related to accessibility and usability, but neither can be recommended as the only option.

Results from a survey conducted in 2013 revealed that the notions of accessibility and usability are related. Yesilada, Brajnik, Vigo, and Harper (2015) showed that the relationship between accessibility and usability exists—most of the 300 people interested in accessibility disagreed that there was no relationship between the concepts and reported that accessibility should be inclusive.

In contrast, other authors perceive web accessibility to be barrier-free web access. According to Abou-Zahra and Henry (2010), in developing regions, the cost of hardware, software and internet access is one of the challenges of web accessibility. In these countries, lower income has reversed the effects of connectivity prices, particularly in isolated areas where there are often limited providers and a depressed economy. Other issues include lack of support for accessibility tools and resources in languages other than English and a lack of policy and recognition of web accessibility in government and corporate sectors (Abou-Zahra & Henry, 2010).

Others claim that poor accessibility is the result of faulty design and use of technology that leads to common accessibility barriers. Developers do not include accessibility features in their web page designs (Peters & Bradbard, 2010); consequently, content is inaccessible if web pages lack proper structure and are deficient in descriptive links, appropriate use of XHTML (EXtensible HyperText Markup Language) structural elements (Lopes, Gomes, & Carriço, 2010), colour contrast and navigation design (Farrelly, 2011; Peters & Bradbard, 2010, p. 7). These issues may be partly addressed by a combination of accessibility-centred web CMS tools, which can be used to prevent common errors in mark-up structure, use of hyperlinks and description of non-text content (such as images), and users who have some level of accessibility knowledge.

Loiacono (2004) assessed the accessibility of 96 American non-profit organisation websites by people with disabilities. Site developers had frequently omitted accessibility features, such as alt text for images (77 websites), text descriptions for image-type buttons (17 websites) and picture links in site maps (11 websites). Overall, the study found several barriers and revealed that 85 of the studied home pages were not fully accessible. Some Priority 1 barriers, defined as ‘A web content developer must satisfy this criterion’(Loiacono & McCoy, 2004, p. 92), are easy to overcome; however, the study did not investigate this aspect further.

A machine-testable, longitudinal study conducted by Hanson & Richards (2013) over 13 years (from 1999 to 2012) aimed to identify changes to accessibility of 100 US and British government agency and other high-ranked websites. Results showed accessibility violations such as the use of alt text for non-text content, improper use of XHTML code and poor coding practice. The study reported some improvement in accessibility levels during this period, especially for government websites, which the authors believed was likely due to changes in coding practices and website technologies. Given that this study was limited to WCAG 1.0 Level A success criteria and to automated testing of website home pages, more violations may have been found had it covered all pages and other success criteria. The study did not indicate any amendments to home pages during this period. Moreover, in 13 years, considerable changes in web technology, browsers, XHTML versions and standards have occurred, but the research did not evaluate the effects of this evolution on the studied websites (Hanson & Richards, 2013).

The research outlined above indicates that the uptake of accessibility has progressed slowly over the 15 years, while web technologies have evolved at a frenetic pace (Harper & Chen, 2012). It appears that accessibility is all too often relegated to the 'too-hard basket' and is considered an add-on rather than an essential aspect of site and content design. These issues relate directly to the primary research question of this thesis, which investigates the use of accessibility-focused web CMS tools. If accessibility-focused web CMS tools can provide enhanced accessibility outcomes with little or no effort on behalf of end users, accessibility outcomes may be improved by default.

2.3.2 Web Accessibility Issues and Barriers

Since the web has become a universal source of communication and information, its use has raised many accessibility issues that frustrate web users, particularly those with special needs who aspire to equal access and usability of websites.

Carter and Markel (2001) reveal that developers cite financial and marketing concerns as the reason for organisations failing to make their websites accessible and that accessibility requires greater time and expense. Developers believed that websites were already accessible and that they were not aware of the need for accessibility.

Lazar, Dudley-Sponaugle and Greenidge's (2004) study 'Improving web accessibility: A study of webmaster perceptions' revealed that webmaster perceive accessibility to be a shared responsibility of all stakeholders. Issues included lack of support for managers and clients, insufficient time and training, confusing guidelines and inappropriate software tools. However, there were some positive findings—most webmasters were aware of accessibility, knew the guidelines and used checking tools in their projects. Some respondents raised doubts about the reality of understanding and applying accessibility features. For instance, this study revealed that 78% of 175 participants were familiar with checking tools, but only 56% were accessible by visually impaired users. Moreover, the study failed to deeply examine the issues revealed and was limited to one type of disability (visual impairment) and one category of respondent (webmasters).

A. P. Freire, Russo, and Fortes (2008b) assert that developers and designers are those most responsible for web accessibility. They are provided with tools, standards and techniques to help in developing accessible systems; nevertheless, the evidence demonstrates an apparent gap between these tools and their application, with low levels of accessibility observed in most of the websites. The authors point to five studies (three in the USA and UK and two in Brazil) on the accessibility perceptions of web developers and designers. Aside from the somewhat optimistic results from the survey conducted by Lazar et al. (2004) (discussed above) in which most of the website maintainers reported a high degree of knowledge about accessibility and its tools (Lazar et al., 2004, as cited in A. P. Freire et al., 2008b, p. 5), other factors influence accessibility. Survey results from A. P. Freire et al. (2008b) show that accessibility awareness in web development was perceived as being related to a broad range of technical factors.

Further issues observed include developers' knowledge, accessibility awareness, training and legal factors, which are reported as being barriers to accessibility. In a survey conducted by the UK Disability Rights Commission (2004, as cited in Freire et al., 2008b, p. 5), few web developers claim to have expertise with respect to accessibility, while those from the academic sector have limited or no knowledge of accessibility (A. P. Freire et al., 2008b). Accessibility awareness was another issue revealed by the developers, who either attempted to make their website accessible or did not consider accessibility at all. According to a 2005 survey by the Enhanced Network Accessibility for the Blind and Visually Impaired (as cited in Freire et al., 2008b, p. 29), this was explained by a lack of technical knowledge and time or because accessibility was not defined as a requirement in web projects and was only considered when requested by customers (A. P. Freire et al., 2008b).

Other developers have claimed a lack of training or understanding of legal requirements as reasons for neglecting accessibility in their projects. In the three sectors (government, corporate and academia) identified in the Freire et al. (2008b) study, nearly half of the participants who did not consider accessibility in their projects stated these factors as being the cause. A lack of legal knowledge of accessibility requirements was also seen as an issue by developers, with 81% of the 68 developers being unaware of Brazilian accessibility laws (A. P. Freire et al., 2008b).

Given the various issues that impede developers and webmasters from providing accessible websites, accessibility barriers are the foremost burden that both contributors and users face. Various barriers for people with special needs exist, depending on the context of each case. Authors of the University of Ottawa (2013) study 'Understanding barriers to accessibility' grouped the barriers found in the learning environment into five categories:

- Attitudinal barriers: emerge from misunderstandings about people with special needs
- Organisational or systemic barriers: arise from procedures, policies and practices that discriminate against and exclude people with special needs in given situations
- Architectural or physical barriers: relate to architectural design or layouts that impede access to buildings, external spaces or halls
- Information or communication barriers: related to sending and receiving information without consideration of people with hearing, vision or learning disabilities
- Technological barriers: related to inaccessibility of devices or electronic documents.

Findings of a three-year ethnographic study on the daily web interactions of 388 aged people included three types of barriers: recall of related task steps, understanding of technical terms and difficulties in using input devices (e.g. mouses). Results of this study suggest that more consideration should be given to 'inclusion, independency and consistency in terminology' to improve web accessibility (Sayago & Blat, 2009). Older adults commonly have various health problems and limited computer skills (Xie, 2011), making it difficult for them to navigate or interact with online resources to access online information in written, animated or recorded media formats.

Further studies on hearing impairments, visual impairments (e.g. blind and low-vision users) and intellectual disabilities have exposed various accessibility barriers that people with these disabilities come across when using the web. The most significant barriers for people with hearing impairments were complex text and the lack of alt text in multimedia content, while images without contrast, links not differentiated by format or text type with small fonts were common barriers for people with visual impairment (A. Pascual, Ribera, & Granollers, 2014). For people with intellectual impairments in educational environments in which technology and online resources prevail, tasks such as using email (logging in, finding and attaching documents, etc.) require practical and cognitive skills, the lack of which are significant barriers when support is not available (Buehler, Easley, Poole, & Hurst, 2016).

These accessibility barriers were specific to certain categories of disability with a limited number of participants in related studies. However, for each barrier mentioned, studies have recommended solutions such as training, support, collaboration and use of existing tools, which may be successful in supporting people with disabilities. Whether the solutions proposed can shed light on the existing obstructions to accessibility, more has to be done to eradicate or reduce these barriers. With continual support, awareness and training, motivation, new perspectives for web accessibility within a global vision, will have a positive impact on the existing accessibility barriers.

Developers should understand important guidelines, technologies and needs, which are necessary for contributors to assimilate and understand. A sole understanding of the varied and numerous guidelines does not promise accessibility (Rømen & Svanæs, 2008). According to Pascual, Ribera and Granollers (2014), when web developers and content authors think about website accessibility, they consider perceivability, operability and robustness, but in most cases forget the principle of understandability (p. 234). Alternatively, they only think about a website being operable and perceivable for people with sensory, motor or cognitive disabilities to access easily. To provide accessible websites, developers should not consider only the guidelines but also be aware of the types of disabilities, the instruments people with disabilities use to assist in their interactions and techniques that can help them to build and implement these technologies to promote accessibility.

The accessibility knowledge domain (shown in Figure 2.1) is directly connected to the evaluation of accessibility, which can be effectively undertaken using three types of testing.

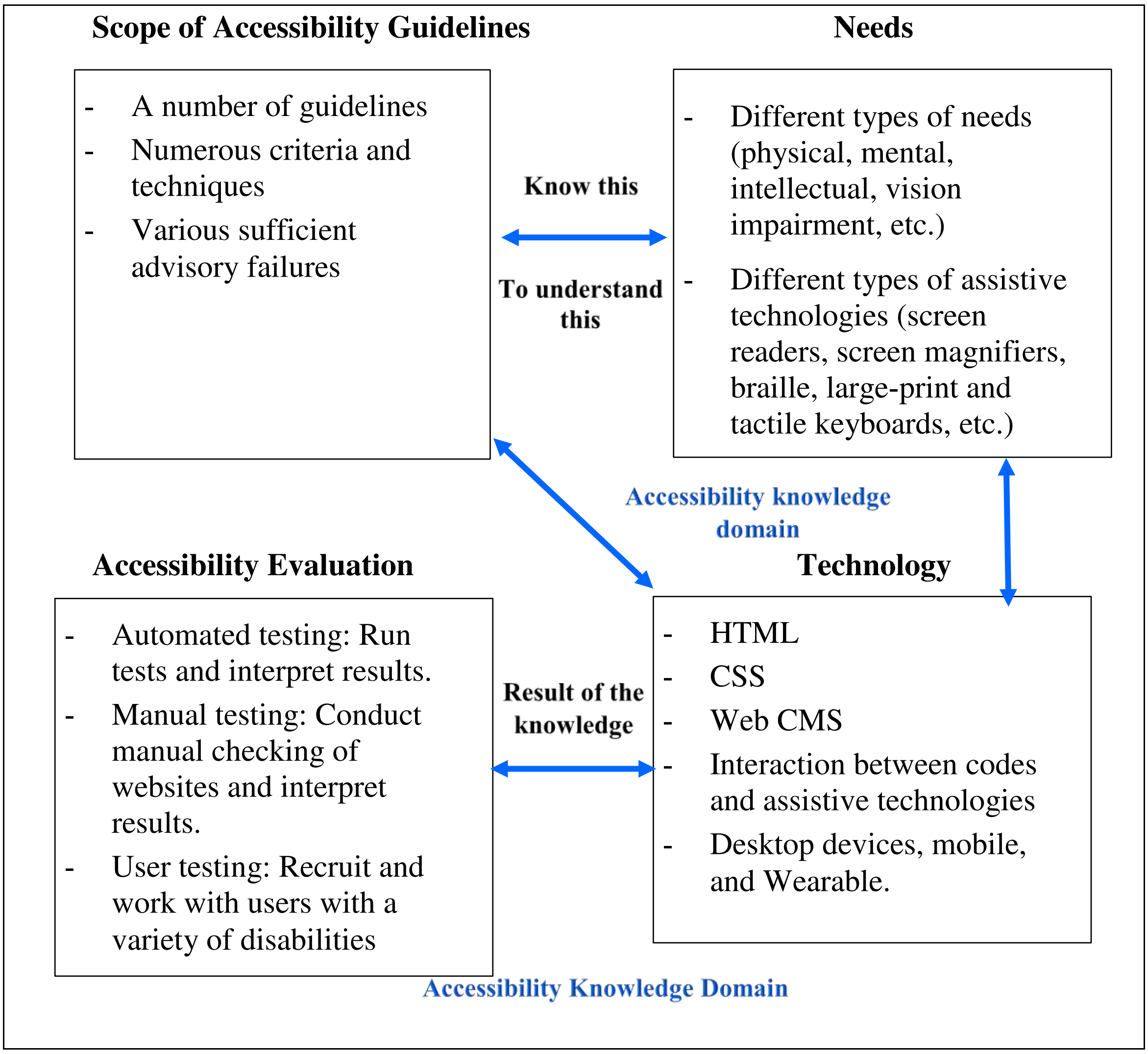


Figure 2.1: Barriers to accessibility

These testing are:

- Automated testing uses professional tools to identify issues on websites and to examine specific requirements (e.g. contrast colour, headings and alt text) (Trewin, Cragun, Swart, Brezin, & Richards, 2010). W3C provides a list of evaluation tools (software programs and online services) to check for accessibility conformance (W3C, 2016f). (Jenkinsen, 2016b) states, ‘Automatic accessibility checking tools are useful to broadly identify problems and start developing a plan to fix them, yet engaging human experts throughout the process is important to achieve the best results' (para.1).

- Manual testing involves human examination of accessibility issues. Evaluators' results depend upon their accessibility knowledge (Mankoff, Fait, & Tran, 2005; Yesilada, Brajnik, & Harper, 2009). According to Leitner, Ciupa, Meyer and Howard (2007), 'Manual tests are good for capturing deep or special cases, which automated tests might not guess; but they cannot yield extensive coverage because of the sheer number of test cases this requires' (para.1).
- User testing is the most recognised method, generally done to perform tasks or explore new technology 'to identify difficulties in use from the users' spontaneous comments and from various performance measures such as task execution time, accuracy of the results, number, and types of errors' (Bach & Scapin, 2010, p. 787). Data obtained from this type of testing rely on the subjective user experience. According to Tan, Liu and Bishu (2009), 'User testing relies mainly on the experience and comments of the users and is usually conducted in a scenario-based environment. As a result, user testing would usually evaluate according to what already exists, rather than to what is possible' (p. 1).

Developers need a comprehensive understanding of all accessibility concepts and factors contributing to barriers to accessibility and should maintain an interconnection between the elements of each accessibility knowledge domain and those of both domains (the first domain regroups scope of Accessibility guidelines, needs and technology, while the second domain regroups the results of the first domain knowledge and the accessibility evaluation), because the success of any one element aspect depends on the knowledge of others.

The literature appears to indicate that web accessibility awareness and an understanding of legal requirements and technical guidelines is still limited at government and corporate levels. Essentially, it is seen as an 'optional extra' that is implemented only at the request of clients in the process of having a website developed or redeveloped. Given that both developers and end users develop web systems and provide site content, awareness of web accessibility requirements and techniques may be addressed with appropriate training of developers and end users.

2.3.3 Training on Accessibility

As shown in the previous section, a number of studies have revealed that a lack of training on laws, standards, guidelines and accessibility hinders developers and webmasters from including accessibility features in their websites. In contrast, other studies have found that training may be paramount for achieving inclusion and accessibility. An online training course to improve the skills of Canadian teachers in operating and integrating assistive technologies in their classes resulted in positive outcomes, with the flow-on effect of having beneficial effects for students with special needs (Chmiliar & Cheung, 2007). Stand4All was a European project that involved elderly people and people with disabilities in training sessions alongside committee members to include them in the development of standards (applying to transport, buildings, products, websites, etc.), with the aim of improving accessibility and awareness of accessibility issues (Strobbe, Mosies, Bühler, & Engelen, 2010).

The W3C website provides materials for training that include the most important accessibility topics and materials (W3C, 2012a, 2013c, 2013d, 2015h). Besides these resources, governments and organisations offer training in the form of workshops, courses, training packages and conferences to the public, institutional staff and skilled contributors such as web developers, designers and managers. Support is provided by advocacy organisations such as Vision Australia (2012), the Disability Services Commission (2012) and WebAIM (2015), among others. Training is offered by experts in the field and is focused on accessibility and W3C guidelines, with the aim of enhancing accessibility for all, especially for those with special needs.

Training on accessibility should be a prime objective of all communities. Government and non-government bodies should implement strategies to raise accessibility awareness, with training as the primary tool for development and design of accessible tools and compliant content for all. Part of this awareness should include an understanding of how assistive technologies provide an interface between an individual with a disability and the digital content they are attempting to access. The wide range of assistive technologies includes screen readers, screen magnifying tools and voice recognition systems (Bradbard & Peters, 2010; Carter & Markel, 2001; Peters & Bradbard, 2010). A number of nations, including Australia, have developed laws and policies pertaining to accessibility of digital information (Al-Khalifa, 2012; Australian Human Rights Commission, 2010; Basser &

Jones, 2002; Depatrtment of Finance, 2014; Grantham et al., 2012; Lazar & Hochheiser, 2013). Internationally, there have been a number of high-profile legal actions against governments and organisations that did not meet accessibility criteria, such as in the cases of Target, the Sydney Olympics and the Massachusetts Institute of Technology (MIT) (Australian Human Rights Commission, 2000; Bradbard & Peters, 2010; Lewin, 2015; Malone, 2015), organisations that mostly perceived accessibility as a burdensome optional extra.

In terms of this research, given that accessibility awareness and improved accessibility outcomes are inherently linked, they are seen as two sides of the same coin. In this case, the awareness aspect is linked to the use of web CMS tools that have some level of built-in accessibility features, besides other tools and standards.

2.4 Web Standards

The term 'standards' has various meanings. In its clear definition, it is 'a document that provides rules or guidelines to achieve order in a given context' (European Telecommunications Standards Institute, 2015, para. 1). In the accessibility field, web standards define web technologies that are grouped in related documents and are published as W3C standards (W3C, 2012b). The term 'web standards' is used concurrently with the term 'web guidelines', which are general specifications and recommendations developed by W3C and recognised by the ISO (ISO/IEC 40500). In this research, the term 'standards' refers to guidelines and accepted recommendations developed by W3C and used widely in the web development community.

In its role in developing and maintaining web technology standards, W3C has helped lead the development of standards aimed at supporting and enhancing web accessibility. Developed by W3C's WAI, the three guidelines—WCAG, ATAG and UAAG—are the most relevant and recognised norms of accessible mark-up technologies. In this section, the literature review scrutinises only WCAG and ATAG as the most prominent standards.

2.4.1 Web Content Accessibility Guidelines

WCAG 1.0 had its foundations in work done by Gregg C. Vanderheiden in 1995 (Ribera et al., 2009). The guidelines were first developed as a series of recommendations focusing on HTML, before being extended from Mosaic only to browsers. In May 1999, the guidelines were published as WCAG 1.0 by WAI (Ribera et al., 2009) as internationally recognised standards for content accessibility.

WCAG 1.0 included 14 guidelines with individual checkpoints and three priority levels—'must', 'should' and 'may'—to evaluate a website's conformance to each level (W. A. Chisholm & Henry, 2005; McHale, 2011; Roig-Vila, Ferrández, & Ferri-Miralles, 2014; W3C, 1999b). Initially, these guidelines on accessible web development were voluntary and were aimed at promoting accessibility for a large variety of users, especially for those with special needs (W. Chisholm, Vanderheiden, & Jacobs, 2001; Ellcessor, 2010; W3C, 1999b).

Over time, they were adopted as specific guidelines by governmental bodies of various countries, including Japan, the US (in the form of Section 508), Canada and Spain (McHale, 2011). Roig-Vila et al. (2014) indicated the key study relate to the web content accessibility across a number of countries, including USA (state government and university websites), Nepal (government websites), Brazil (municipality websites), Spain and North America (university libraries), which were largely concerned with conforming to the guidelines.

Various studies have shown low WCAG compliance across a vast number of internationally recognised websites. Results from a longitudinal study conducted from 1998 to 2008 showed that the adoption of guidelines in 6000 home pages examined was still low, with only 10% implementing accessibility guidelines after more than 10 years (Harper & Chen, 2012). Similarly, results from another study of 108 disabilities-related websites in Taiwan showed a low conformance level for 72 websites (Li, Yen, Lu, & Lin, 2012). Such levels may be caused by poor awareness of accessibility guidelines in the web development community and by the organisations that procure their services. According to Lazar et al. (2004), web developers and webmasters are likely to follow existing tools and guidelines but proclaim to find them confusing (Lazar et al., 2004) and too complicated and detailed, making them slow to be adapted (Harper & Chen, 2012). Lack of time and training on use of guidelines and poor compliance with legislation may also contribute to the problem. If developers are limited by time, they may ignore guidelines for which they are not trained or mandated to follow.

WCAG 1.0 was criticised for its shortcomings, with some proclaiming that the guidelines were too detailed, difficult to understand and challenging to implement to achieve accessibility conformance (Baguma, Stone, Lubega, & van der Weide, 2009, p. 1). As a result, web accessibility guidelines can lead to diverse interpretations or outright rejection by developers who are seeking straightforward guidance for site development (Kelly, Sloan, Phipps, Petrie, & Hamilton, 2005).

Further, WCAG 1.0 was HTML-focused and technology-dependent, leading to it becoming outdated as the web continued to change and evolve rapidly, especially with emerging technologies such as Cascading Style Sheets (CSS) and JavaScript. Some considered a large number of WCAG 1.0 checkpoints problematic when conducting automated assessments of websites, especially when trying to achieve compliance with any of the specified priority levels (Parmanto & Zeng, 2005). To address these problems and other issues involving WCAG 1.0, a new approach to the guidelines was required, ultimately leading to the WCAG 2.0 recommendations in 2008.

The WAI released an updated version of WCAG in December 2008, building on the core concepts of WCAG 1.0. Reid and Snow-Weaver (as cited in Rømen & Svanæs, 2012) described the aims of WCAG 2.0:

> One of the major goals of WCAG 2.0 was to describe the requirements for web content accessibility in a technology neutral language, so that it could be applicable to any W3C or non-W3C technology, such as CSS, SMIL, SVG, XML, PDF or Flash in addition to HTML and XHTML. A second major goal of WCAG 2.0 was to ensure that the requirements are all objectively testable, so that policy makers can adopt them unchanged. (p. 2)

WCAG 2.0 encompasses 12 guidelines organised under four core principles: perceivable, operable, understandable and robust (POUR) (Kelly et al., 2009; Rømen & Svanæs, 2012; W3C, 2015i). Each guideline has three levels of conformance, with A being the lowest and AAA being the highest (W3C, 2015j). Criteria are designed to be technology neutral, written as testable statements to be used over time (W3C, 2015i). As with the WCAG 1.0 guidelines, a large number of studies have used WCAG 2.0 to conduct website conformance testing using automated or manual methods or a combination of both.

In 2012, an automated testing study carried out by Pribeanu, Marinescu, Fogarassy-Neszly, and Gheorghe-Moisii (2012) to evaluate the accessibility of 60 Romanian municipal websites showed guideline violations in both home pages and second pages of every website evaluated in the study. Most errors detected by the validator were related to the first WCAG 2.0 principle (Perceivable), with an average of 52.98 errors per page for home pages and 49.37 errors for the second web pages. Remarkably, results indicated that none of the web pages had passed conformance level A. The average number of errors recorded was 69.10 for home pages and 58.81 for the second pages. These results contradicted a 2010 finding, with the authors stating that 'this is different from 2010 when we noticed a clear orientation of developers towards the accessibility validation of the home page and less interest to perform a thorough validation of each page' (Pribeanu et al., 2012).

In another study, Kuzma (2009) revealed that all 130 sites of UK members of parliament were not compliant with either WCAG 1.0 or WCAG 2.0. Although WCAG 2.0 was only a year old and was not applicable at a large scale nor mandated by the UK Disability Discrimination Act, it was used in the automated testing, which exposed many errors and warnings. For instance, a total of 504 serious errors (failure) and 1,415 warnings (mostly for Priority 1 and 2) were identified in all sites tested using WCAG 2.0.

Both studies were based on automated testing, which checks only for violations of guidelines. Brajnik (2008) argues that automated testing should not be relied on as an evaluation method because it can lead to false positives and false negatives, which were found in a previous study in 33% and 35% of cases, respectively. The use of automated testing on its own is not an adequate accessibility evaluator (Brajnik, 2008). Other methods such as user testing should be considered to help identify problems that may be missed in automated testing. In some studies, testing focuses mainly on website usability by people with disabilities, which is the primary consideration of the ISO approach regarding the meaning of accessibility (Rømen & Svanæs, 2012).

Rømen and Svanæs (2012) investigated the effectiveness of using WCAG to determine levels of web accessibility. Two groups—one group of seven people with disabilities and a control group of six people—were studied to distinguish between accessibility and usability problems of websites in two municipalities with similar content (text and images). Results indicated that participants with disabilities faced more accessibility and usability problems than did other participants, even with efforts made to improve these issues. When combining WCAG 1.0 and WCAG 2.0, even more accessibility problems were identified. This combination reflects the view that accessibility concerns are not related to the application of guidelines alone, but also to other components, including the usability concept, which should be added to WAI's definition of accessibility (Rømen & Svanæs, 2012). However, this does not comply with the views of other researchers in the field, who argue about the relationship between accessibility and usability. Some perceive this relationship as complex and unclear (Petrie & Kheir, 2007) or consider accessibility as a subcategory of usability (Thatcher, 2003, as cited in Petrie & Kheir, 2007, p. 2). Others encompass both concepts under the banner of 'universal usability' (Shneiderman, 2003, as cited in Petrie & Kheir, 2007, p. 2). The definition of accessibility remains elusive, and compliance with WCAG guidelines alone does not appear to ensure the usability and accessibility of websites and web content.

Even with its shortcomings related to technologies, users, technical issues and policies (Reid & Snow-Weaver, 2008), WCAG 2.0 has been adopted by a large number of providers, developers and access technologies. Concerning its usefulness, the guidelines were adopted as ISO standards in 2012 (ISO/IEC 40500:2012), which is identical to WCAG 2.0 (W3C, 2014). Ten years later, with the evolving technologies, it became necessaire to update these guidelines and address the requirements of all users with special needs, especially those with low vision, users with cognitive or learning issues and users with disabilities on mobile devices that were not sufficiently considered in the last guidelines (Kirkpatrick, O Connor, Campbell, & Cooper, 2018). They also consider the needs of specific technologies and users, including no English native speakers.

In 2018, W3C released WCAG 2.1 as a supplement, but not a replacement, to the existing guidelines (Kirkpatrick et al., 2018; W3C, 2018e). WCAG 2.1 keeps WCAG 2.0' standards and success criteria with the addition of new criteria and support aiming to improve the accessibility of web content on desktops, laptops, tablets, and mobile devices. This backwards compatibility to WCAG 2.0 means that the sites' conformance to WCAG 2.1 also conforms to WCAG 2.0 and sites' existing content can be reviewed to conform to the new success criteria (W3C, 2018e). In WCAG 2.1, the Accessibility Guidelines Working Group added seventeen new success criteria (five are Level A, seven are Level AA, and five are Level AAA) that empower the content in the way to be perceivable, operable, understandable and robust, and fill the gaps perceived in WCAG 2.0 regarding mobile, cognitive and low vision areas. The shift to the new version is crucial for updating websites in the way that they keep their compliance with both guidelines 'versions and remain compliant with the legal accessibility requirements (Moreno & Martinez, 2019).

Since its final version, WCAG 2.1 has been recommended by the Accessibility Guidelines Working Group as a new conformance target for better accessibility improvement and for anticipating future policy changes (Kirkpatrick et al., 2018). In September 2018, the European standard Organisations updated the EN 301 549 version named "Accessibility requirements suitable for public procurement of ICT products and service" using WCAG 2.1 for "web content, electronic documents, and non-web software, such as native mobile applications", it showed that there was a complete integration of the new guidelines' version (Abou-Zahra, 2018). In Australia, the Australian Federal Government has committed to updating the existing websites based on the seventeen success criteria since their publication, for the other services, specifically those related to websites and web-based service delivery, it was recommended to include theses new criteria at level AA, otherwise they could be rejected from the Government procurement (Canaxess, 2019). Some studies revealed that the new success criteria in WCAG 2.1 had an optimistic implication on either the accessibility of the content or the software (Moreno & Martinez, 2019; NASDAQ, 2019; White, 2019); though, ongoing efforts continue to evolve the accessibility by improving the guidelines throughout new "Accessibility Guidelines" or "Silver" project which is a task force of WCAG working group.

Silver is the successor of WCAG (expected to be released in 2020), WAI's Accessibility Guidelines Working Group is working on this long-term project that is considered to be a significant improvement of web accessibility (Kirkpatrick et al., 2018). W3C (2019c) states that the projects' guidelines "will address the process of making content and functionality accessible to people with disabilities, including the roles of content authoring, user agent support, and authoring tool support. These guidelines will provide a base for continued evolution of accessibility standards" (W3C, 2019c); currently, the project is in its experimentation phase, but the structure-related research was completed in March 2018, and a summary of this structure is publicly released.

Although WCAG 2.0, is still considered a benchmark for accessibility guidance and implementation, WCAG 2.1 is recommended to be used to take full advantages of the accessibility efforts.The following section outlines other evolving accessibility guidelines that may be embedded in web development technologies and tools to assist with accessibility compliance of websites and content.

2.4.2 Authoring Tools Accessibility Guidelines

In addition to content guidelines, W3C released ATAG 1.0 in February 2000 to help drive web accessibility outcomes. In the first version, W3C provided developers with guidelines for building accessible authoring tools that could be used to create accessible content (Brewer, 2003; Hanson & Richards, 2013; Rapoza, 2000; W3C, 2000). ATAG 1.0 contained seven guidelines, three priority levels and a set of checkpoints assigned the terms 'essential', 'substantial' and 'beneficial' to meet accessibility. An additional document, 'Techniques for Authoring Tool Accessibility Guidelines 1.0', was created to support developers by giving examples and references on the ability of checkpoints and tools to satisfy checkpoints (W3C, 2000). Figure 2.2 shows the image insertion/editing interfaces of two popular web e-learning CMSs and how they manage accessibility of those images, in this case by providing alt text and title descriptors to images via an interface that translates values into HTML code.

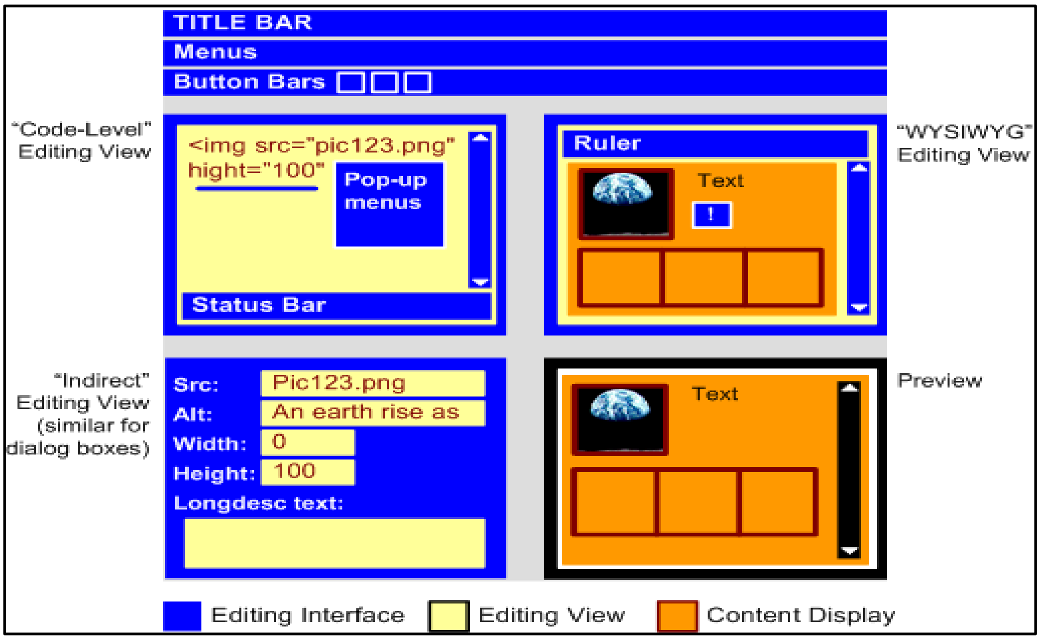


Figure 2.2: ATAG 'What you see is what you get' authoring tool interface

(W3C, 2006)

Following on from ATAG 1.0, a second version was developed and designed with WCAG 2.0 compatibility in mind. It encompasses two parts: Part A provides guidelines for the design of accessible authoring tool user interfaces and part B supports and promotes the production of accessible web content by all authors. Figures 2.2 (above) and 2.3 (below) represent one aspect of what ATAG 2.0 Part B requires in terms of providing interfaces that allow for the addition of accessible web content (in this case, images).

Figure 2.3: Editing interfaces of modern web CMS tools

(*Screenshot taken from Edith Cowan University instance of Blackboard 9.1*)

ATAG 2.0 is being reviewed by the international group Authoring Tool Accessibility Guidelines Working Group and was recommended in 2015 as a candidate for WCAG 2.0 (W3C, 2013a). Part A of ATAG 2.0 is linked to the four POUR principles of WCAG 2.0, referring to the editing views of web authoring tools:

1. Principle A.1: Authoring tool user interfaces follow applicable accessibility guidelines.
2. Principle A.2: Editing views are perceivable.
3. Principle A.3: Editing views are operable.
4. Principle A.4: Editing views are understandable.(Lazar, Goldstein, & Taylor, 2015, p. 66).

This relationship is consolidated by the application of WCAG 2.0's terminology, which is a requirement for ATAG 2.0. However, this close connection may lead to confusion and difficulty for web designers when attempting to apply both guidelines.

ATAG 1.0 was used in a study conducted by Lopez, Pascual, Menduina, and Granollers (2012) to analyse the accessibility of six CMSs. Two CMSs were selected and evaluated for compliance with Levels A and AA. Results showed that, in their default configuration, the tools did not fulfil ATAG 1.0 requirements. In addition, even in the final configuration of the modified web CMS used in the study, ATAG compliance was not at its highest level. However, the systems were able to provide a development environment that led to the production of mostly accessible content. In another study focusing on accessibility features of content produced by non-professional developers, ATAG was correlated with factors that made the user-generated content accessible in some way. Even if users did not have knowledge about accessibility, they did introduce aspects of accessibility guidelines in the content. Because the participants used systems that either did not allow underlying code changes, had built-in accessibility features or were based on a template, positive accessibility outcomes may have arisen from an inability to make the content inaccessible. In the research, the authors mapped all the techniques used by participants to create accessible content to comply with both WCAG 1.0 and ATAG 2.0. They claim that the content generated by these users was accessible and that accessibility was likely achieved as a result of using ATAG-compliant tools (García, González, & García, 2009).

This claim does not agree with that of Moreno, Martinez and Ruiz (2008), for whom the shift of users from being passive to being content creators poses accessibility problems for web page development. This shift is caused by the lack of training in accessibility and standards, the use of editing tools that generate codes with no respect to accessibility issues and users who are unable to use editing tools. To preserve accessibility, the authors propose solutions centred, first, on the design process with the use of accessible content templates and, second, on the editing process with the use of models and rules to acquire a semantic structure. Finally, they suggest the addition of WCAG annotation in content to ensure compliance with the guidelines when creating web pages (Moreno et al., 2008).

Ultimately, ATAG is designed for two types of users—those with disabilities who wish to use web authoring tools to develop websites and web systems (Part A) and those who wish to use web systems to create or add web content that is accessible (Part B). This latter aspect of the evolving standards features prominently in this thesis, with selected aspects of the specification being used for data collection and analysis. How users perceive accessibility issues and solve them using web interfaces that promote accessibility lies at the heart of this study.

This section has provided a summary of the literature relating to both WCAG and ATAG, which have been created to promote accessibility through the use of accessible tools, documents and interfaces, helping to implement accessibility features and components for all users, particularly those with special needs who need to access web content through particular technologies. This is the focus of the following section.

2.5 Assistive Technologies

The continual growth of the web and the services it provides has engendered the development and expansion of new technologies that allow ease of access to a broad range of information seekers. Assistive technologies are critical in allowing global access to website content by people with special needs. Assistive technologies consist of software and hardware that support corporal, cerebral or emotional functioning in typical activities (Baguma & Lubega, 2008) in the computing environment (Media Access Australia, 2012; Sierkowski, 2002) or in performing tasks that would otherwise be difficult or impossible (University of Washington, 2013). To access web content, people with special needs use various technologies that are adapted to their needs and disabilities (physical or cognitive).

Assistive technologies offer various tools for each type of disability to accomplish tasks or to access the web. For example, blind people can use screen readers to read and translate text or braille into audio formats (Pal, Pradhan, Shah, & Babu, 2011; Southwell & Slater, 2012), while people with low vision can use screen magnifiers to enlarge screen content (Blenkhorn, Evans, & Baude, 2002) and improve text readability. Both of these tools, besides others, are embedded in most operating systems and mobile devices. People with physical disabilities can use various pointing devices such as mouse devices, touchpads, joysticks, touchscreens, light pens and eye tracking in their daily activities (W3C, 2017b) . They may also use voice recognition software, which may be obtained from open sources or purchased at various prices depending on their built-in features. People with cognitive disabilities can use text-to-speech software that reads the content of electronic text (e.g. ebooks, text on web pages and Word documents) in a natural voice (Schroder, 2009, as cited in H. J. Park, Takahashi, Roberts, & Delise, 2017). Other tools have been developed along with the expansion of innovative devices (e.g. iPads and iPhones) and applications such as ereaders (e.g. ZoomReader) to help with accessing various information sources. Prominent companies such as Macromedia and Apple have integrated accessibility features in their authoring software to allow adequate information access (Sierkowski, 2002). A combination of assistive technology tools, such as text-to-speech with magnifier or braille, is often used to improve access, although not all devices are affordable or easy to use.

Even with the significant capabilities that assistive technologies offer to people with special needs, they have some limitations that may hinder web accessibility. Screen readers cannot express the meaning of images when alt text is omitted (WebAIM, 2013c). WebAIM (2018a) states that alt text has benefits in helping users with cognitive or other types of disabilities understand, read and search for information or understand the meaning of graphs, charts or images.

The perception that alt text has the potential to ensure image accessibility by users of screen readers or other text-to-speech software or those who switch off images should direct developers to be aware of its prominence and use. However, evaluation tools check only for the presence or absence of alt text, which will not improve accessibility if it is not appropriately utilised (Asakawa, 2005). For example, the accurate use of alt text image descriptors can allow a screen reader user to understand what the image represents as well as whether it is useful or not. This can be illustrated by the example of a legally blind person taking a saved or printed image of a product they wish to purchase into a retail store. If the alt text associated with a product's image is unclear or ambiguous, the user cannot be certain that the image on the given page is of the product they wish to purchase. Failing to describe the nature or the content of an image means that the content is inaccessible and fails in providing the functions it serves.

Alt text serves several functions:

- It may be read by screen readers in place of an image, allowing the content and function of the image to be accessible to those with visual or certain cognitive disabilities.
- It may be displayed in place of the image in browsers if the image file is not loaded or when the user has chosen not to view images.
- It provides a semantic meaning and description of images, which can be read by search engines or be used to later determine the content of the image from the page context alone.

The key point is that, without alt text, computers and screen readers cannot analyse an image and determine what the image represents. As developers, text must be provided to the user which presents the content and function of the images within the web content. (WebAIM, 2018a, para. 3)

Without the presence of alt text, the task does not meet Success Criterion 1.1.1 of WCAG 2.0 guidelines, which states that 'all non-text content that is presented to the user has a text alternative that serves the equivalent purpose (W3C, 2019b). Without alt text, it becomes difficult or impossible for people with special needs to visualise the page layout. Additionally, they cannot browse the web efficiently as 'it takes much more effort for screen-reader users to navigate the same collection by stepping back and forth between the index and the linked content pages' (Gadde & Bolchini, 2013, p. 84), especially when indexes lack hints to find efficient links while searching (Yang, Gadde, Morse, & Bolchini, 2013).

Another issue is related to excessive clicks of the keyboard or lack of other additional methods, impeding access to information for users with impaired vision or mobility disabilities (WebAIM, 2013c). Language support is also an issue for users of screen reader because a high number of people with special needs are non-native English speakers and cannot access content that is not translated in their language when translation functions are not available in the system (Pal et al., 2011).

To overcome these issues, developers should consider all the requirements and elements that contribute to improved accessibility and provide adaptive devices and interfaces that consider the accessibility guidelines for each category of assistive technology. However, this cannot be achieved without government support and a legal framework.

2.6 Legislative Frameworks

For many countries that support accessibility, web accessibility is important as a means of global inclusion and rights for everyone, regardless of gender, religion, race, colour and disability. In this regard, governments and organisations have been working to establish laws and policies to make the web and its content accessible, especially to people with special needs.

2.6.1 Accessibility Legislation

In 1992, the Australian Government passed the *Disability Discrimination Act 1992* (*DDA*) to protect the rights of people with disabilities and to ensure their inclusion in Australian society (Basser & Jones, 2002; Tyler, 1993). Basser and Jones (2002) state:

> The *DDA* is in fact a human rights instrument with a sophisticated mechanism for operationalising the human rights of people with disabilities. The ideal process for achieving equality for vulnerable groups involves a commitment to change on the part of the individuals concerned, the state and the community as a whole. (p. 6)

Tyler (1993) states that the three cornerstones of the Act are the elimination of discrimination, the promotion of equality and the recognition of rights of people with disabilities. These may be realised by considering the growth of this population, the nature of the disparity affecting their lives and government efforts to address inequalities. The authors argue that the *DDA* is unlikely to solve all social problems and, even with the support of other policies, it is challenging to achieve fulfilment of the Act's aims.

Campbell (2005) criticises the aims of the *DDA* and its implementation in the real world. The Act aims to reduce discrimination of people with disabilities; however, lawmakers have misinterpreted the definition of disability as stated in the Act. This confusion has led to the judgement of disabilities, rather than behaviours, as the source of the problem, which contradicts the statement in Section 3: 'To eliminate, as far as possible, discrimination against persons on the ground of disability' (as cited in Campbell, 2005, p. 204). Consequently, future cases may encounter a similar situation, which may result in people with disabilities believing that the Act serves to widen the gap between them and non-disabled individuals, hindering its effectiveness.

The Convention on the Rights of Persons with Disabilities stipulates that 'equal access is a right' and that 'any failure to provide full access to the web and other internet-based technologies for people with a disability may be seen as a violation of human rights' (Australian Human Rights Commission, 2010). Failure to comply with the *DDA* regarding information accessibility is a breach of the Act and proprietors of websites may be solicited, as occurred in the case of the Sydney Olympic Games (discussed in the following section).

Legal protection is also provided by the National Transition Strategy, which came into effect in 2010 and provided a four-year strategic plan for WCAG 2.0 (Priority Level AA) to be implemented into government websites by 2014. It is mandatory for government sites to be accessible or developers may face juridical pursuit under the *DDA* (Australian Government Information Management Office, 2010). In her research, Conway (2014) acknowledges the role of the National Transition Strategy in increasing accessibility awareness in government organisations. She found that compliance with guidelines was significantly better compared with that of non-governmental agencies. In their study 'Corporate website accessibility: does legislation matter?' Loiacono and Djamasbi (2013) state that 'legislation affects accessibility levels in two ways: indirectly through increasing the quantity of accessibility tested websites, and directly through requiring that accessibility standards be met' (p. 119).

Other countries also have specific legislation. In the US, four major laws govern disability rights:

- Section 504 of the Rehabilitation Act (1973) prohibits institutions discriminating against people with disabilities from receiving federal financial support (Smith, 2002).
- Section 508 of the Rehabilitation Act (1998) requires federal agencies to provide accessible technologies to employees and the public (Kelly et al., 2005; Lazar & Hochheiser, 2013).
- Americans with Disabilities Act (1990) addresses intentional or non-deliberate discrimination against people with disabilities (Kelly et al., 2005).
- The 21st Century Communications and Video Accessibility Act (2010) requires technology to be designed for accessibility by people with special needs (Lazar & Hochheiser, 2013).

Each of these laws specifies the organisation it covers as well as stipulating the domain of application and technical requirements.

The UK *Disability Discrimination Act 1995* provides a set of rights for people with disabilities to inhibit the discrimination they may face. The Act states that 'It is now against the law to refuse to serve a disabled person, provide an inferior level of service or charge more for goods or services, for a reason related to their disability' (Disability

Policy Division, 1997). Websites were not covered in the legislation (Kelly et al., 2005). Nevertheless, the Act states that the availability and use of services for people with special needs may apply to the web and its content. It also mentions 'access to and use of information services' as examples of services that disabled people could access. In 2010, the *Disability Discrimination Act 1995* was replaced by the *Equality Act 2010,* which increased clarification of discrimination (Government Equalities Office, 2013). In 2011, the Equality and Human Rights Commission (2011) published a statutory code of practice, stipulating that service providers must adjust their services to be accessible by people with disabilities.

Other countries around the world have implemented their own legislation. European Union law mandated WCAG 2.0 as the standard guidelines to be implemented by 2010 (Grantham et al., 2012). Countries without accessibility legislation adapt and apply W3C guidelines to the development of their sites (Al-Khalifa, 2012).

Globally, legislation has been established to protect people with disabilities and allow them to access internet services without discrimination, particularly for government sites for which accessibility should be the primary concern. Some laws are complex while others have been misunderstood. Consequently, owners of websites that lack accessibility for people with special needs may face legal battles.

2.6.2 Web Accessibility Legal Battles

Universally, legislation aims to direct organisations to develop and provide accessible sites to all type of users; however, webmasters continue to provide sites with accessibility issues for people with disabilities. In the US, complaints against business sites have been and continue to be filed.

In 2003, the National Federation of the Blind sued America Online because its software did not accommodate screen readers. The case was dropped after an agreement with the company to solve its accessibility problems (Carter & Markel, 2001). Three years later, the National Federation of the Blind sued Target, this time for breaching the Californian *Disabled Persons Act*, which mandates equal access for disabled people to all public areas, and the Californian *Unruh Civil Rights Act* for discriminating between disabled and non-disabled patrons (Bradbard & Peters, 2010). The case was closed with a settlement for Target to pay $6 million to claimants and the provision of an accessible website, which was monitored by the National Federation of the Blind for the following three years (Benjamin, 2010; Danielson, 2008).

Another battle against the discrimination of people with special needs occurred in Australia. Bruce Maguire, who was blind, lodged a complaint with the Australian Human Rights Commission regarding the inaccessibility of the Sydney Organising Committee for the Olympic Games website. Three issues were discovered: a lack of labels on images and image maps, no links from the Schedule page to the Index of Sports page and inaccessibility to the Results Tables (Australian Human Rights Commission, 2000). The claim cost the Olympic committee $20,000, payable to Bruce Maguire (Australian Human Rights Commission, 2000; webAIM, 2000).

The Australian Coles Supermarkets' case was another complaint about discrimination towards people with vision impairments. In 2014, a blind woman Gisele Mesnage sued the chain, under the Disability Discrimination Act (DDA) 1992, after her difficulties in making an online order when using a screen reader; the case finished in 2015 with a settlement with both parties and Coles agreeing to make the website more accessible (Mediaaccess, 2015; Smerdon, 2015).

In 2015, MIT and Harvard University were sued over a deficiency of captions in their online learning materials (video and audio recordings). The case was filed by deaf activists, who considered the inaccessibility of site content for people who were deaf or hard of hearing a violation of anti-discrimination laws. MIT denied the claim, while Harvard awaited the Justice Department's decision for guidance (Lewin, 2015; Malone, 2015). In 2016, 'the district court rejected Harvard and MIT's motion to dismiss, holding that they failed to show that the plaintiffs' claims under Section 504 and Title III were 'facially implausible' (Charmatz, 2017, p. 3).

From 2017 to 2018, the number of accessibility litigations rose in the United States. In one year, the number of claims brought to the Federal Court by individuals and class actions (hotel shuttle services and online hotel reservations systems) went from 815 to 2285 cases. Most of the cases were under Title III of the Americans with Disabilities Act (ADA) (Title III is the section that prohibits discrimination based on disability) (Conroy, King, LePage, & McGarrell, 2019). In 2018, a mid-year report from the law firm "Seyfarth" revealed that 4965 complaints were filed in the Federal Court, these complaints were also related to the Americans With Disabilities Act, in the business field for their websites compliance' issues (Marks, 2019; Vu, Launey, Ryan, & Fritz, 2018).

Unlike Australia -that has legal standards for the websites-, in recent years, America has seen a growth number of litigations related to the accessibility of websites under the Americans with Disabilities Act Title III (ADA) (Shapiro, 2019). The Act was claimed to lack precise and clear compliance requirements (Kumar, 2019; Miles, 2019); companies are confused about legal standards to follow in regards to web accessibility, as a consequence, they seem unable to provide compliant websites to people with special needs. Even though, in 2019, the Department of Justice has restated that Act Title III applies to websites, some businesses continue in not providing compliant websites as the lawsuits continue to rise.

> Based on the current trends, we think website accessibility lawsuits will not only continue, but will continue to increase in volume. At this point, we would not be surprised if the number of lawsuits filed in 2019 is 2.5 times higher than 2018 (Shapiro, 2019, para. 4).

The majority of the lawsuits filed to the Court are settled between the parties with a cost impact to the companies, i.e. the Target case that finished with six million dollar settlement. The legal action enforces the compliance to the guidelines and raises awareness amid content authors; the claims have alerted the website owners to consider compliance to the guidelines and consider planning accessibility for upcoming developments to their sites.

2.7 Creating Web Content

The web is no longer optional because it has become omnipresent in every domain and in everyone's lives. To ensure universal access, governments, corporations and information providers have aimed to build and publish websites with compliant and useful content and well-designed web pages, incorporating guidelines and web technologies that involve HTML and multimedia packages.

Since the early days of the web, content developers have been challenged to learn, understand and use all necessary tools to create content, especially using HTML, for publication on the web. HTML was created when the WWW was conceived in the 1990s and has continuously evolved to enable creation of available and accessible content in web pages. The web has gradually progressed from Web 1.0 (the 'web of content') to Web 2.0 (the 'web of communication') to Web 3.0 (the 'web of context and things' or 'web of cooperation') to Web 4.0 (the 'web of thoughts' or 'web of integration'). This is summarised in Table 2.2 and defined in Figure 2.4. Progress has occurred over three web generations and has contributed to shaping the creation of web content.

Table 2.2: Web 1.0, 2.0 and 3.0 summary

Web 1.0 (Crawl)	Web 2.0 (Walk)	Web 3.0 (Run)
Mostly read-only	Widely read-write	Portable & personal
Company-focused	Community-focused	Individual-focused
Home pages	Blogs/wikis	Livestreams/waves
Owning content	Sharing content	Consolidating content
Web forms	Web applications	Smart applications
Directories	Tagging	User behavior
Page views	Cost per click	User engagement
Banner advertising	Interactive advertising	Behavioural advertising
Britannica online	Wikipedia	The semantic web
HTML/portals	XML/RSS	RDF/RDFS/OWL

Source: https://flatworldbusiness.wordpress.com/flat-education/previously/Web-1-0-vs-web-2-0-vs-web-3-0-a-bird-eye-on-the-definition/

Figure 2.4: The web expansion from web of content to web of thoughts (SlideShare, 2019)

Web 1.0 was the first generation of the web from 1989 to 2005 and was somewhat unidirectional (Aghaei, Nematbakhsh, & Farsani, 2012; Bernal, 2010). It was defined as the ‘web of information connections’ (Prasad, Manjula, & Bapuji, 2013)and the ‘read-only’ web (Berners-Lee, 1998) and was focused on company home pages. Pages were static (Aghaei et al., 2012; Prasad et al., 2013; Rudman & Bruwer, 2016; Silva, Rahman, & Saddik, 2008) and content was created by experts working for businesses or organisations who owned the sites (Silva et al., 2008), which only showed information. Users were not contributors—they could read information, but not interact with it (Rudman & Bruwer, 2016). Webmasters and content generators controlled the content of the sites they created by writing HTML, uploading and managing files and dealing with browsers. Sites were typically focused on online commercial transactions and advertisements to promote sales to users who could only view static information (Bernal, 2010). Despite its characteristics and limitations (see Figure 2.5), Web 1.0 was challenged by the arrival of new protocols (e.g. HTML, HTTP and URI), concepts, tools and standards. The move to a new era, Web 2.0, was the inevitable result of these changes.

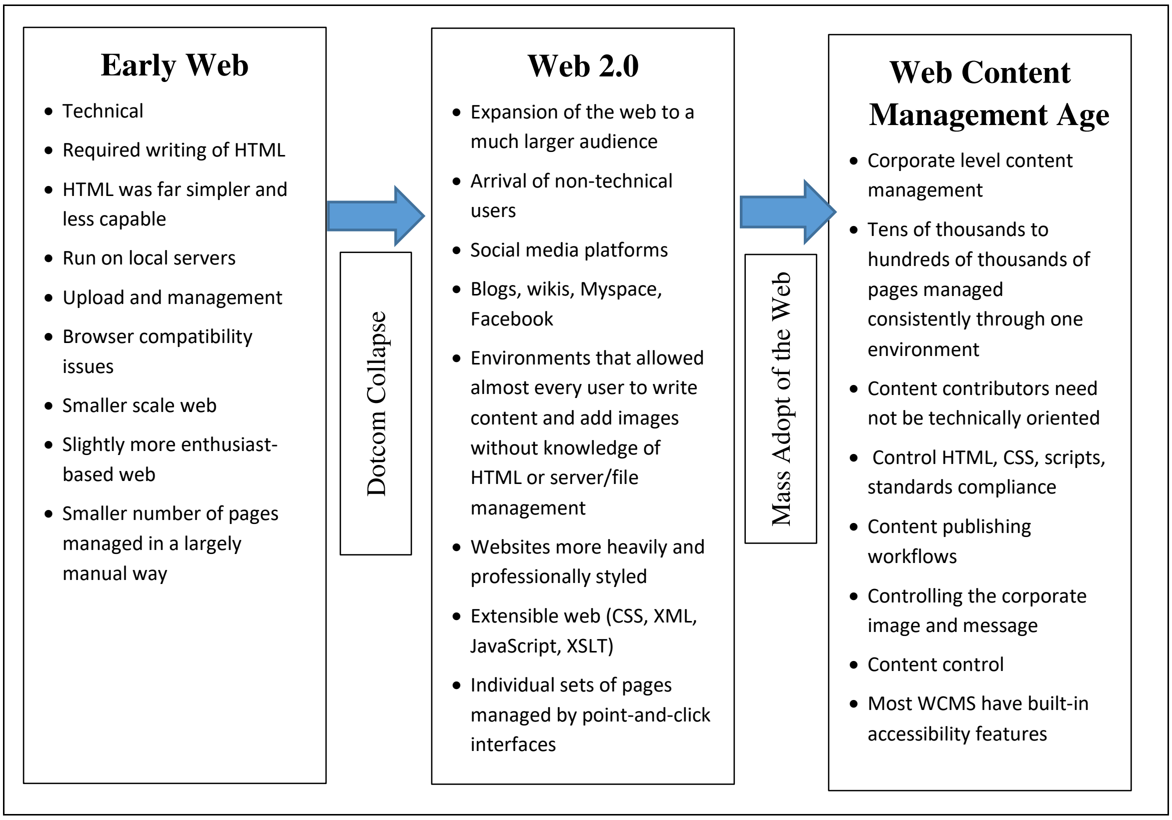


Figure 2.5: Evolution of the web

2.7.1 Web 2.0

Web 2.0 or the 'read-write' web was the second generation of the WWW and an extension of Web 1.0. O'Reilly (2007) defined Web 2.0 as 'the web as platform' in which software applications were built on the web rather than on desktops. The dotcom collapse, which resulted from an enormous number of rash investments in internet-based companies, leading to a market crash, 'marked some kind of turning point for the web' (O'Reilly, 2007, p. 17), which subsequently expanded to a broader audience. From Web 1.0 to Web 2.0, the number of users globally increased from 45 million in 1996 to 1 billion in 2006 (Prasad et al., 2013). During this period, through various platforms, users, even those with non-technical experience, became content participators. As Web 2.0 evolved, HTML web pages shifted from being static to dynamic, allowing greater interaction, creation and information sharing (Buffington, 2008; Cronin, 2009; Granitz & Koernig, 2011; McLoughlin, Lee, & Australasian Society for Computers in Learning in Tertiary Education, 2007; Rudman & Bruwer, 2016).

Users were able to not only cooperate but to connect with multiple other users via social media platforms, which are associated with the rise of the social web and the development of new platforms, including YouTube, ezines, Flickr, Facebook, wikis, blogs, Rich Site Summary (RSS) feeds, web application programming interfaces (APIs), video streaming, web applications, online web services and mashups, and have facilitated user communication, contribution and connection (Aghaei et al., 2012; Bernal, 2010; Buffington, 2008; Kitsantas & Dabbagh, 2011). Web browsers such as AJAX and JavaScript were introduced for the development of websites, and the extensible web (e.g. CSS and Extensible Markup Language [XML]) contributed to enhancing the structure, navigation, content and appearance of web pages.

These new technologies and tools allowed users to shift from being content consumers to content creators. Rudman (2010, as cited in Rudman & Bruwer, 2016) categorised the crucial features of Web 2.0 into the following three groups:

1. Community and social: The ability of a consumer to view, create, edit and share content by means of the web.
2. Technology and architecture: Software and applications with multiple device and platform compatibility.
3. Business and process: Cloud technologies, software and resources made available on a network. (p. 136)

The use of website applications facilitated the creation of content that could be manipulated and shared between users and media, reinforcing the idea of 'more interaction with less control' (Aghaei et al., 2012, p. 3). Web 2.0 enabled members of the general public—including novice users—to actively contribute to and shape content using open source, open content and open editing to satisfy their own needs and those of others (McLoughlin et al., 2007). This contribution strengthened the era of communication and the sharing of information and dynamic content. The web became receptive to users' comments and developers' improvements, leading to its transition to the next generation.

2.7.2 Web Content Management Age

The continual progress of the Web, from the web of content to the web of communication to the web of contribution has given rise to new concepts, tools and technologies for creating, managing and publishing substantial content by active contributors, or as some have defined, Web 3.0 (Irtaza, Jaffar, & Muhammad, 2015). The focus is on developing and using web CMSs that are adapted to corporate strategies, allowing content creation, management and user engagement and interaction.

In the third generation of the web, content has become diverse and the volume of data has amplified to the point of it being uncontrollable (Berman, 2001; McKeever, 2003, p. 2). The amount of content has exceeded business expectations, and strategies for attracting more customers, who have become content generators, and have failed in their objectives because they have engendered what Schaefer (2014) describes as ‘content shock’ (para. 14). Since the advent of Web 3.0, numerous websites have been established to serve the creation of complex content and the web has evolved from being static to being complex and dynamic. New online businesses have proliferated, meaning that user requests have grown, and applications on server programs must handle individual requests to ensure global satisfaction (Souer & Joor, 2010) and allow users without technical knowledge to develop, manipulate and publish dynamic content. The need to organise and maintain this ever-growing volume of content has driven the development of web CMS tools, which provide structured interfaces for end users to gather new content and to manage existing content. To understand these systems, it is crucial to consider the various definitions of web CMS in the literature. There appears to be no standard definition and the concept differs from person to person.

Since their appearance in the late 1990s, web CMS tools have proliferated, with hundreds of such systems now available across a large number of domains, including blogs, document management, content management, learning management, ecommerce and process flow management (OpenSource CMS, 2015).

Web CMSs are used by organisations for the creation and maintenance of web content by non-expert users (Harney, 2009; López, Pascual, Masip, Granollers, & Cardet, 2011; Lopez et al., 2012; Meike, Sametinger, & Wiesauer, 2009). Dijana and Dragica (2012) note that these software systems are used by people with limited programming and designing skills to create and manage website content efficiently, allowing for independence from supportive agencies and information technology experts and the efficient development of website content. Consequently, users who are not web developers or who do not have skills in programming languages such as HTML may contribute to the web (Short, 2010).

Other authors consider web CMSs as a means of collecting information from various sources in formats that can be stored, managed and published (Harney, 2009; Mican, Tomai, & Coros, 2009). A study by Mican et al. (2009) sought to identify preferred open-source web CMS tools (including Joomla, Drupal, SharePoint, WordPress, Mambo, TYPO3, OpenCms and Plone) in a group of respondents. Functionalities offered by these systems include editing, organising and sharing capabilities. Tools typically contain an editor permitting limited editing of source code, share options to import functionalities and organisation tools to manage user-contributed content. In addition to the latter, web CMS tools offer the ability to secure selected content and provide role-based restricted access functionality (Mican et al., 2009). Such functions, along with other capabilities specific to the domain in which the web CMS operates, are at the core of most web CMSs.

A study by Kane and Hegarty (2007) found that web CMS tools are used by web content providers to publish information on the web. Systems can provide powerful management capabilities, allowing accessibility and compliance with standards. This ability was positively reflected in the findings of their study on the compliance of libraries with web standards and guidelines. However, because the findings were only applicable to a small academic library and the project was ongoing, the study was limited.

In contrast, Burzagli, Gabbanini, Natalini, Palchetti, and Agostini (2008) dispute that web CMSs are compliant with accessibility requirements:

> A number of [web] CMS have been developed which, at least, take accessibility and conformance to standards into consideration and try to account for it in the process of page generation (even if examples can be encountered where claims about these two aspects are not confirmed by the facts). (p. 3)

Given their content gathering and control capabilities, web CMSs are now used globally and their market share trends have evolved significantly over the last decade. According to McKeever (2003), the market growth for these systems has been rapid, with an annual estimated growth of 29% worldwide, exceeding that of other systems and technology markets. W3Techs reports that yearly trends for the use of web CMSs for website management show an ever-increasing rate. For some web CMS tools, especially WordPress, Drupal and Joomla, growth is particularly strong. For example, WordPress grew from 13.1% to 23.3% of market shares in the five years from 1 January 2011 to 1 January 2015 (W3Techs, 2015), then to 59.7% on 1 January 2019 (w3Techs, 2019), with an enormous number of posting activities and WordPress usage. Horsman (2018) states that ‘WordPress reported that in October 2016, almost 24 billion pages hosted by their services had been viewed, with over 65 million posts made to WordPress sites and over 11 million new pages created’ (p. 1).

Common web CMS features, besides those illustrated in Figure 2.4, have been identified by Mican et al. (2009) and Short (2010). Mican et al. (2009) grouped these features under seven elements: system requirements, support, ease of use, management, flexibility, built-in applications and security. These features are paramount as they incorporate tools, documents and time- and effort-saving functions. For developers, they incorporate online help from various contributors via forums, communities and online support, while for users, they offer control capabilities and security functions for content. While web CMS tools offer a great deal of functionality, often at no cost, those coming from the open-source community may be vulnerable to malicious attacks on applications, databases and data contained within them (Meike et al., 2009).

There is a small but evolving body of literature regarding accessibility of web CMSs. Preferred web CMS tools and e-learning environments are among the most featured types of systems in the literature. Multiple studies have been conducted in the educational sector in which e-learning systems have thrived, identifying various accessibility-related problems. A study conducted by Iglesias, Moreno, Martínez and Calvo (2014) evaluated three e-learning tools—Moodle 1.9.4, ATutor 1.6.2 and Sakai 2.6.0—focusing on four parameters and compliance with ATAG 2.0 and WCAG 1.0 in terms of their user interfaces. The authors explained their rationale for using WCAG 1.0, which they believed provided more mature testing options than did WCAG 2.0, which provided only partial testing tools and methods. Results showed the existence of barriers in each system that would likely affect their accessibility by elderly people and those with disabilities. Templates provided in ATutor needed improvement, while support for JavaScript was lacking. Both ATutor and Sakai lacked tables for content layout, and content editor features were found to be inaccessible in Sakai. These findings indicate that these systems lacked compliance with WCAG 1.0 and ATAG 2.0 and were likely to have limited accessibility (Iglesias, Moreno, Martínez, et al., 2014). These results are surprising given that ATutor was ‘designed with accessibility as a priority’ (ATutor, n.d, para. 1).

Other studies have also evaluated the accessibility of Moodle when used as an authoring tool. One study examined the system from a visually impaired perspective (Buzzi, Buzzi, & Leporini, 2009) and another from an administrator and teacher perspective (Calvo, Iglesias, & Moreno, 2014). In the first study, problems identified were related to navigation difficulties, accessing content via the keyboard and reading content using a screen reader. These are all accessibility issues for blind people, especially those who use screen readers to access content. However, this study evaluated only the accessibility of web pages generated by Moodle, not the accessibility of Moodle itself. In contrast, the second study considered the accessibility of both the system and the content. Diverse accessibility problems were found in the tool interface, default HTML editor, keyboard interactions, content generated by Moodle and the underlying help documentation. These problems made the tool inaccessible for users of screen readers and non-compliant with ATAG 2.0 (Calvo et al., 2014). The study was limited to only one type of tool and disability and focused on Moodle 1.9, which was not the latest available version at the time.

Other research has examined open-source web CMSs and the content they manage. Results showed that the most frequently used CMSs (Plone, Joomla, TYPO3, eZ Publish, OpenCms and Drupal) were not compliant with ATAG Level A in the default installation of their editors, while only some were compliant with WCAG 1.0 in terms of web page analysis. While some web CMSs such as Plone, Drupal and eZ Publish performed better than others, none of the six CMSs in the study allowed for the generation of accessible content (López et al., 2011). In contrast, Burzagli et al. (2008) argues that open-source web CMSs with proper attributes, greater accessibility and content-publishing methods may be appropriate tools for building websites. These attributes are characterised by five principles: effective design and structure, varied contributions by users and authors, compliance with laws and standards, capability of adapting to various devices and global acceptance by primary contributors (authors, users and administrators) (Burzagli et al., 2008). With respect to these principles, the authors' solution was successful. Despite the barriers and technical issues, which were solved according to the selected web CMS, Joomla 1.5 was easily reused, accepted and implemented in the Italian Research Institute's web portal.

Mirri, Salomoni, Roccetti and Gay (2011) add that when standards are implemented in web CMS e-learning platforms, WCAG requirements may be satisfied and platforms can deliver accessible content. To achieve this, the authors refer to the Integrated Management System Global Learning Consortium specifications, which were designed to address personalisation or transformation of learning content (Mirri et al., 2011, p. 2) and the ISO final draft International Standard 24751 (Mirri et al., 2011, p. 3) as standards implemented in ATutor 1.6.2. Results showed that positive accessibility outcomes were achieved when features such as allowing users to customise display settings to display content for blind and low-vision users were added.

Even with the various solutions suggested by some studies, accessibility of the most frequently used web CMSs such as WordPress, Joomla and Drupal (W3Techs, 2015) is still a concern. In their websites, web CMS providers outline information regarding accessibility of their systems and their commitment to increasing that accessibility over time. For instance, Drupal states in its website that it is committed to the promotion of accessibility and making the product accessible for people with disabilities (Drupal, 2015). Nevertheless, findings from a previous honours study by this researcher show that the administrative interfaces of Drupal had low accessibility and were largely non-compliant with WCAG 2.0 (Diaz, 2014) .

Users, including non-experts, also use other common digital authoring platforms; in recent years, social media has become an almost ubiquitous platform for content creation (Mount & Martinez, 2014); their ability to connect, communicate, create and share has turned them into the ultimate tool for web authoring in different fields (Walaski, 2013). The number of applications has grown significantly in either number or use with massive increases in authored content that should accessible by, including those with a disability.

Social media are interactive computer-mediated of various technologies that enable the interaction, connectivity, creation and sharing of information or opinions through virtual space (Baccarella, Wagner, Kietzmann, & & McCarthy, 2018; Mount & Martinez, 2014; Obar & Wildman, 2015; Parveen, Jaafar, & Ainin, 2015). Kaplan and Haenlein (2010, as cited in Pasquini & Evangelopoulos, 2017, p. 2) delineate social media as ‘‘a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content”. Content is created with a broad range of Web 2.0 tools such as wikis, blogs, social bookmarking, video sharing, social networking services, professional networks to name but a few (Darwish & Lakhtaria, 2011; Walaski, 2013).

From 2004 to 2019, there has been a phenomenal expansion of users, especially in platforms such as Facebook, the most prominent social network application; going from one million users in 2004—date of its creation—(Hall, 2019) to 2.41 billion monthly active users, as of second quarter of 2019 (Statista, 2019b). The popularity of the social media platforms is due to the new technologies like smartphones used by "nearly 80 percent of all social media time spent on mobile" (Sterling, 2016) and also to the conveniences offered by these in terms of interaction, collaboration and contributions between different users (Mount & Martinez, 2014; Walaski, 2013) within different domains and industries (Akar & Topçu, 2011). A survey on the "Adoption of social media for public relations by non-profits organisations" revealed that among 409 employees in non-profits organisations —generated from Forbes, National Charity Seal Program, Accredited Charity Directory (through the Better Business Bureau), and the Charity Navigator (independent charity evaluator online) (Curtis et al., 2010)— 404 employees working with civic services use "some form of social media" to realise their organisational aims (Curtis et al., 2010). Similarly, another study conducted by Parveen et al. (2015) showed how important social media can be to the performance of firms in the Malaysian Stock Exchange. Senior managers of six Malaysian companies asserted the positive impact of social media such as Facebook, Twitter, Blog and Youtube. For these companies, social media are used to expand customer services through marketing , advertising, service promotions, market research, information share with partner organisations and monitoring competitor.

As Media Access Australia (2017) highlighted, the most popular social media platform "Facebook", improved its accessibility from about 2009 when it teamed up with the American Foundation for the Blind (AFB). For a continual accessibility improvement and immediate problem solving, Facebook has formed a support team for both users and staff members. Likewise, Twitter's accessibility has improved, and there is a team committed to solving any accessibility issues (Media Access Australia, 2017a).

On the other hand, the accessibility of the other social media applications, such as LinkedIn, Google+, and Youtube, has been a concern. Even with the presence of some accessibility features, users with special needs have faced difficulties relating to the absence of alternative text, poor colour contrast and a lack of video captioning (Jenkinson, 2017; Media Access Australia, 2017).

Social media has contributed to a significant increase in creating and sharing content by diverse users (expert or novices). Social media applications have encouraged people to interact and connect on the Web via the available networked social media applications (Naeem, Peng, Fei, & Shiqiang, 2011), but the level of the accessibility of that content depends on the accessibility of the application used to author accessible content. In 2019, users of social media are reaching 3.48 billion (WeAreSocial, 2019), and the volume of shared content, including messages, posts and links, is so large as to be "Impossible to measure" (Clement, 2019); None of the social media platforms are fully accessible (at the time of writing), so still make participating in the social web more difficult that it should be.

Word processing is another authoring application used by people to publish documents without having to physically write the entire document (Meyer, 1983). Over time, more advanced features have been added to word processors such as *What You See Is What You Get* (WYSIWYG). Word processors became cloud-based applications in 2000 with features similar to those of a traditional computer application, i.e. embed graphs or videos, apply different margins in the document, define and run macros, merge files besides other features (Market Business News, 2019; Oppenheim, 1981; Quiroga, 2014).

In October 2019 the number of monthly active users of Office 365 reached 200 million (Redmond, 2019). These applications that can be word processing packages or multimedia authoring tools (Mahesh & Mittal, 2009) are used to create digital content that "comes in many forms, from text and audio and videos files to graphics, animations, and images" (Mullan, 2011). Their features vary, depending on the application used such as Word, Excel, PowerPoint, OneNote, Outlook, Publisher, Access, Skype for Business, and the other Microsoft Office for mobile and iPad. Microsoft Word, the most preferred product of Microsoft (Webaim.org, 2016a), is described by Microsoft' contributors as "a full-featured word processing program for Windows and Mac operating systems”(Microsoft, 2019).

The latest versions of Microsoft Word include features that improve accessibility. Word offers many features helping to enhance the content of a document to be compatible with assistive technologies such as the screen reader (Bureau Of Internet Accessibility, 2017a). Most features of word processing software are those helping in creating accessible content such as headings structure through a hierarchy, alternative text for images, creation of accessible links, selection of adequate colours and fonts. It also includes an accessibility checker that provides useful recommendations and support (Bureau Of Internet Accessibility, 2017a). The checker allows to detect and correct accessibility issues and provides “Inspection Results” of classified problems into three categories:

- **Errors:** content that makes a document very difficult or impossible for people with disabilities to access.
  - *Example: an image with no alt text.*
- **Warnings:** content that in most—but not all—cases makes the document difficult for people with disabilities to access.
  - *Example: a link with text that is not descriptive of its function.*
- **Tips:** content that people with disabilities can access, but that might be better organized or presented.
  - *Example: skipping from a first-level heading to a third-level heading (Webaim.org, 2016a)* (Webaim.org, 2016a, para. 12)

Word processing, with its different software, provides opportunities to non-experts to create digital content that could be accessible. As word processing tools allow documents to be exported to other files type (PDF or HTML) and formats, or to be created and copied to a text editor in order to be published throughout websites or any social media, the accessibility of the created digital content depends on the accessibility features offered by the software itself and by the level of accessibility knowledge of the user.

In investigations related to web CMSs accessibility and other digital authoring platforms, such as social media and word processing, every system has some accessibility issues and authors agree that full accessibility of these systems is yet to be achieved. The content generated by these systems depends on their level of accessibility as well as other barriers that hinder the production of accessible content.

2.8 Barriers to Accessible Content

Ever since the web has become an essential information medium, there has been an increasing awareness about providing content that is accessible by all users via any device. However, there are still barriers that hinder the creation of accessible content. In the literature, it is recognised that W3C guidelines developed and issued by WAI are useful and beneficial for producing a high level of accessible content for all users (Amsler, 2003; Clegg-Vinell, Bailey, & Gkatzidou, 2014; Peters & Bradbard, 2010; W3C, 2018d) when adopted and applied efficiently. However, various issues have made their application and adoption problematic for designers and developers.

Early standards were criticised for their complexity. WCAG 1.0, the dominant guideline at the time, appeared simple, but its focus on checkpoints made it difficult to understand, imprecise and vague with respect to its recommendations (McHale, 2011; Providenti & Zai, 2007, p. 5). Criticism of WCAG 1.0 led to the development of WCAG 2.0, which was released in 2008 to address the limitations of WCAG 1.0. However, WCAG 2.0 has also attracted criticism for its length (Farrelly, 2011), complexity and indecipherability (Baguma et al., 2009, p. 2), imprecision and confusing nature (Providenti & Zai, 2007, p. 7). In his article 'To Hell with WCAG 2.0', Clark (as cited in Joseph, 2006) stated:

> In an effort to be all things to all web content, the fundamentals of WCAG 2 are nearly impossible for a working standards-compliant developer to understand. WCAG 2 backtracks on basics of responsible web development that are well accepted by standardistas. (para. 3)

Results of some studies have shown that developers and people involved in web development lack knowledge about web accessibility standards. A survey on the accessibility awareness of 613 people involved in web development projects in Brazil found that only a few considered accessibility in their projects. Given that 39.15% of participants had no knowledge of WCAG, a lack of accessibility training was considered one of the reasons impeding consideration of accessibility (Andre P. Freire, Russo, & Fortes, 2008a).

Another survey conducted in 2005 by the Enhanced Network Accessibility for the Blind and Visually Impaired indicated that of 269 participants in the Health on the Net project

(29% webmasters, 21.9% managers, 7.8% web content editors and 29% from non-specified areas), only 36% attempted to create accessible websites. Limited knowledge of web accessibility guidelines, time constraints and poor technical knowledge were the main reasons for not considering accessibility (as cited in Andre P. Freire, Russo, & Fortes, 2008, p. 89). However, a 2012 study that included 60 web developers with various levels of experience found that even when developers knew about accessibility guidelines (76.7%), only a few (4%) applied them. The researchers argued that lack of time, awareness and knowledge were the reasons for the failure to adopt accessibility guidelines (de Borba Campos et al., 2013, cited in Antonelli, Rodrigues, Watanabe, & Fortes, 2018, p. 3).

None of these studies holistically represent all people involved in web development, with every sample being specific to the aim of the study. However, there is a need to extend the research and investigate the reasons for failure to adopt and apply web accessibility guidelines, especially when they are not mandated by governments.

Creating content in the design phase without considering accessibility thwarts the principles of accessible design and excludes some categories of users from accessing web content. (WebAIM, 2016) has provided a list of basic principles to address common accessibility issues in the design of structure and content. Some of these principles, when omitted in the interface design, can hinder people with special needs from accessing web content. Vassallo (2003, as cited in Grantham et al., 2012) summarised these design issues:

> Small fonts, poor contrast backgrounds (either too low or too high), large blocks of text, cluttered pages, animated images or blinking/moving text, automated page or form redirects, excessive use of capitals or italics, fully justified text (resulting in uneven spacing between words); and wordy and confusing use of English. (p. 3)

To overcome these concerns and the other accessibility design issues, Trewin et al. (2010) state that accessibility considerations should be included in all design stages because problems can arise and be addressed at any point in a product's life cycle. If the design process encompasses a faulty design and the website excludes equal access, web accessibility cannot be achieved (Peters & Bradbard, 2010). Although a wide range of tools, software, guidelines and supportive documents are available, few developers design with accessibility in mind. Developers exclude people with special needs by designing sites with inaccessible content because of common barriers such as absence of alt text for images, unstructured web pages, poor colour contrast, videos without captions and difficulty in reading linear tables (Peters & Bradbard, 2010, p. 9). These issues may be addressed by adequately training developers and designers to improve their knowledge, skills and awareness about inclusive designs for people with special needs and encouraging them to put that training into practice to achieve inclusive design for a broad range of users.

2.9 Role of Accessibility Practice

Since the advent of new technologies, laws and guidelines, the concept of accessibility has been an essential focus of most governments and corporations. However, accessibility has not yet achieved its full potential and accessibility issues remain pervasive (André, Freire, Bittar, & Fortes, 2008; Brown & Hollier, 2015; Carvalho et al., 2018; Comeaux & Schmetzke, 2013; A. P. Freire et al., 2008; Goette, Collier, & White, 2006; Michalska, You, Nicolini, Ippolito, & Fink, 2014) . Both front and end users use available resources and opportunities to perceive and understand accessibility, allowing them to meet the objectives of all users. As seen in Section 2.3.3, training on accessibility provided by governments and advocacy organisations via workshops, courses, training packages and conferences aims to support all contributors in developing an enhanced and accessible content for all web users.

Many governments around the globe have mandated the implementation of W3C accessibility guidelines in their official websites. To this end, W3C provides numerous resources to assist those involved in content and technology development and to promote accessibility and usability of websites and all other web media by all users, with or without special needs. Nevertheless, some resources are outdated and do not reflect the existing state of the available technologies, i.e. keyboard shortcuts are different from those used to navigate a website. Other resources are inaccessible by some disability types; for instance, the shockwave plugin is recognised not to be accessible for deaf and blind people (WebAIM, 2019d). Even with these issues, the W3C's support is valuable. By providing supportive tutorials and other materials, W3C aims to assist with the implementation of accessibility. Supportive materials include topics for accessibility presentations and development of web accessibility training for all potential audiences, including senior management, people with accessibility needs and web design students (W3C, 2018b, 2019a). It also provides training resources for 'before and after' demonstrations that 'examines the rationale for organizations to address accessibility' and 'explores how accessibility can drive innovation' (W3C, 2018a).

As well as Section 508 standards, W3C resources are used by organisations to promote accessibility through training, conferences, talks, seminars, presentations and courses to put into practice all accessibility components, from design to the final output, and to improve access for people with special needs who use various assistive technologies. Some studies have shown that practice through accessibility simulations increases awareness of accessibility and helps increase understanding of the challenges faced by people with disabilities in accessing online resources (Papadopoulos, Pearson, & Green, 2008) and by learners with special needs (Moore & Lewis, 2015; Pearson, Koppi, & Australasian Society for Computers in Learning in Tertiary Education, 2006). Pearson et al. (2006) note that simulations promote optimistic attitudes and assist academics in understanding and adopting resources related to people with special needs:

> Simulations of interactive computer activities as well as video clips of an expert blind user accessing learning activities through a virtual learning environment (VLE) were used to instill some empathy for the academic with the disabled student experience, to help them to understand the problem of access, to motivate them to adopt new practices and to persuade them that it is worth the effort. (p. 3)

Herbert (2000) argues that coupling simulation with other learning methods supports learners to take adequate measures and simplifies disability awareness. To be more productive and effective for people with special needs, training should incorporate disability simulations and other methods to improve positive attitudes that stimulate awareness. Herbert (2000) states that additional simulation learning methods should include:

> (a) direct social interaction with people with disabilities through recreational pursuits, (b) reading material and/or viewing and listening to audio-visual materials (films, videotapes) about disability issues, (c) attending support group meetings that are open to the general public (e.g., Alcoholics/Narcotics Anonymous), (d) listening to panel discussions conducted by persons with disabilities, and/or (e) taking formal coursework

> in academic disciplines that address various disability aspects (e.g., rehabilitation counselling, special education, and therapeutic recreation). (p. 3)

These simulations, particularly in the teaching field, may provide beneficial opportunities. Hayman (1978, as cited in Herbert, 2000) provides a rationale for the use of simulations:

> As a general teaching strategy, simulations have been used because they are reported to: (a) facilitate interaction among participants, (b) provide opportunities to practice decision-making skills and resulting behavioural consequences, (c) convey important social messages, (d) facilitate exploration of personal values, and (e) foster empathy and insight regarding events and issues being simulated. (p. 2)

Although accessibility simulations are used in learning strategies, their role is pivotal to understanding the concept of disability, for which accessibility is mainly developed. However, this role is not the only one. Accessibility practice engenders motivation through simulations combined with other strategies (e.g. the use of videos) that enable people to share their experiences and motivate others to apply new practices and make changes that support e-learning accessibility (Pearson et al., 2006). Studies have identified four primary motives for students enrolling in Massive Open Online Courses: to fulfil current needs, to prepare for the future, to satisfy curiosity and to connect with people (Uchidiuno, Ogan, Yarzebinski, & Hammer, 2016; Zheng, 2015; Zheng, Rosson, Shih, & Carroll, 2015). These findings indicate that motivation is a crucial concept for personal satisfaction derived from tools aimed at general access and practice.

Developing skills is another outcome of accessibility practice. All accessibility training courses or other forms of training should provide in-depth and ample content to satisfy individual and organisational needs. Training content aims to increase participants' skills and knowledge through various topics relating to accessibility and its principles, including web accessibility principles, guidelines and laws, access and use of the web by people with special needs, use of assistive technologies, use of mark-up languages such as CSS, JavaScript, ARIA, HTML and HTML5 and evaluation of site accessibility (Australian Computer Society, 2015; University of South Australia, 2019; WebAIM, 2019a). Feedback from an Australian Securities and Investments Commission online manager, who participated in a course provided by the University of South Australia, reflects the benefit of the course:

> This course gave me the skills I needed to dive straight in and perform an accessibility audit on my organisation's website, along with the opportunity to discuss, clarify and address issues and concerns with other students, which helped me move forward. (University of South Australia, 2019)

webAIM (2019b) indicates that, for web developers, the development of accessible sites is simple, but 'the problem is that the majority of web developers do not know most of the basic web accessibility techniques' (para. 1) because their knowledge on disability access issues is limited. However, training supports them and helps them to transfer their skills and knowledge to web content providers. In four surveys conducted between 2005 and 2012 of Brazilian web developers, a lack of training was reported by participants as one problem of many, including poor enforcement, time issues, lack of knowledge, lack of experts and numerous standards (Antonelli et al., 2018). Similarly, the results of a survey of 613 people involved in a web development project in Brazil showed that only a few considered web accessibility because of a lack of accessibility training (A. Freire, Russo, Fortes, & Proceedings of the international cross-disciplinary conference / Web accessibility Proceedings of the international cross-disciplinary conference / Web, 2008).

To promote accessibility, the challenge is to be aware of the important tenets of accessibility by providing information, tools, laws, regulations and policies to enforce its implementation and address all issues. Otherwise, the development and improvement of accessible content for all will remain a challenge.

Despite the efforts made by governments, institutions and organisations to improve accessibility, the issues related to this concept remain a burden to be overcome through training and awareness to promote a level of expertise and increase the number of accessibility experts. Nevertheless, building this expertise requires time to achieve the five levels of proficiency provided by the Dreyfus model of skill acquisition (used in the education and operations research fields): novice, advanced beginner, competent, proficient and expert (Dreyfus, 2004). As individuals progress through these levels, they gain experience and proficiency and develop skills and abilities to make appropriate decisions:

> We need to understand that our value as accessibility professionals isn't just in our ability to tell people what is wrong, but why it is wrong, and specifically what must be done to fix it. If the [information and communication technology] developers are doing

> things wrong, we need the ability to educate them on how to do it right. That requires, at least at some level, a degree of technical expertise in the platforms you work in. (Groves, 2012, para. 12)

An increased awareness and understanding about disability and the development of skills and motivation along with practical training to gain experience and expertise provides effective returns for accessibility. When developers, webmasters and web designers are knowledgeable and are willing to implement accessibility in their development and design, they contribute to transferring their knowledge to others through training and support. Training should include all accessibility topics to elevate skills in developing accessible websites and stimulating accessibility awareness among contributors.

2.10 Awareness Versus Action

In recent years, governments and organisations have focused on accessibility awareness to increase knowledge and understanding of accessibility and to promote empathy through communication, collaboration and cooperation of all contributors. However, the value of awareness is progressively being reflected through an understanding and empathy of disability issues rather than solely focusing on human–computer interactions.

ISO/IEC policy states that technical committees should 'raise awareness and provide information for standards developers on the issue of Accessible Design, taking into account ISO/IEC Guide 71 on addressing the needs of older persons and people with disabilities in standards work' (ISO, 2000, p. 7). According to the ISO (2001), the aim of this design focus is to widen the number of users by

> designing products, services and environments that are readily usable by most users without any modification, by making products or services adaptable to different users (adapting user interfaces), and by having standardized interfaces to be compatible with special products for persons with disabilities. (p.2)

When the needs of all people, specifically those with special needs and older people, are considered in the design process, the accessibility of equipment, services and facilities is assured, unless accessibility strategies are disregarded.

Results from a study on how student designers perceive and design for people with various disabilities and those without special needs and how they are encouraged to consider accessibility in the design process (referred to as accessible design) following a one-year design course at two different universities were promising. Given that student perspectives shifted towards accessible designs for various populations, students were able to design with accessibility in mind (Shinohara, Bennett, Pratt, & Wobbrock, 2018).

Another study investigated how designers incorporated Design for Social Accessibility to create accessible designs. The findings from this study showed that when professional designers were provided with suitable resources and tools such as Design for Social Accessibility aware and had experience in using them, even if limited, they considered disability in their designs and came up with solutions to engage users with or without disabilities (Shinohara, Wobbrock, & Pratt, 2018). The reasons for emphasising accessible design include ensuring global access, meeting legal requirements and improving usability of sites or content for all users (Brown & Hollier, 2015). However, designing for accessibility is not enough to achieve desired aims if contributors have limited knowledge about disabilities and do not understand the needs of all users.

Gaining empathy for disability and understanding disability issues cannot be achieved without consideration of people with special needs. Studies have shown that empathy increases from understanding the experience of others (Ludi, 2007; Waller, Hanson, & Sloan, 2009), mainly those with special needs for whom designers and engineers are required to find accessible solutions (Ludi, 2007; Martin-Escalona, Barcelo-Arroyo, & Zola, 2013; Waller et al., 2009). Nonetheless, only working with people with special needs excludes those without special needs. It is through a broad inclusion of people that contributors to accessibility can promote engagement of all users; hence, they should increase their understanding, cultivate empathy and find solutions for all situations that satisfy all users. Strickfaden, Devlieger, and Heylighen (2009) argue that developing empathy is a challenge for designers when users are absent and propose a ‘dialogue’ strategy to re-establish the connection between designers and their clients:

> Empathy is the ability to understand, be aware of or be sensitive to the feelings, thoughts and experiences of another. From this, the notion of dialogue is advanced as a strategy towards developing and maintaining empathy throughout the design process. (p. 448)

Dialogue promotes understanding and inclusive design because it involves commitment, engagement, shared experiences and collaboration between users and designers through workshops and disability simulations, although the latter have been criticised for their negative consequences such as confusion, embarrassment, apprehension, discomfort and helplessness experienced by people with special needs (Nario-Redmond, Gospodinov, & Cobb, 2017). Nevertheless, simulations are recognised as a good teaching strategy. According to Herbert (2000), simulations '(a) facilitate interaction among participants, (b) provide opportunities to practice decision-making skills and resulting behavioural consequences, (c) convey important social messages, (d) facilitate exploration of personal values, and (e) foster empathy and insight regarding events and issues being simulated' (p. 1).

The role of awareness is pivotal for the comprehensive learning of new concepts and notions that help in achieving accessibility for all, especially when all contributors are considered in the design process. Improving accessibility and usability through active awareness and a better understanding of users' needs and expectations contributes to building knowledge and improving empathy towards people with disabilities. Additionally, accessibility and usability are improved through experience, contribution and understanding when skills are adequately put in action.

2.11 Chapter Summary

This chapter presented a review of various concepts related to this research. The first section gave a brief overview of the development of the web as a working space as well as content creation, publication, communication and diffusion of information to various users. The second section focused on the contributions of W3C to developing standards that have contributed to the growth of the web and the creation of accessible websites. The third section discussed accessibility and its conflicting definitions, perceptions and approaches. Various accessibility issues, including financial, managerial, technical and legal, were identified, which may be addressed through training and increased awareness of all contributors.

Sections 4 to 6 focused on the most prominent W3C standards, WCAG 1.0 and 2.0 and ATAG 1.0 and 2.0, which aim to enhance and improve accessibility through documents, interfaces and supportive tools such as assistive technologies, facilitating access for people with special needs. Legislation has been created in various countries, including Australia, USA, UK, the EU and others, to protect the rights of people with disabilities and allow them to file complaints in case of exclusion or other issues.

The remainder of the chapter explored the evolution of three generations of the web and its content, which has become sophisticated and dynamic, requiring systems to create, manage and publish content by novice users. However, even with the recent availability of web CMSs, accessibility has not reached its potential because of various barriers such as guideline limitations, limited or absent accessibility knowledge and poor design. Given that these guidelines have become government requirements in some countries, their implementation and practice are being supported via training, courses and simulations that help to raise awareness for all contributors and build knowledge and skills that help in providing content that is accessible by every web user.

CHAPTER 3: RESEARCH METHODS AND DESIGN

This chapter outlines the study design and methods used for data collection and analysis of this research. It includes the approach suitable for the context of this study, the various instruments used to collect data, including the survey questionnaire and pre- and post-tests questionaries (Appendix A), and the process of selecting tools and participants. A brief explanation of statistical methods and tests adopted and their effectiveness in communicating the findings is included.

Given that this research involved human participants, the researcher was responsible for the ethical conduct of all processes, including participant recruitment, data collection and design of all research instruments used by the participants.

3.1 Research Methods

This research aimed to investigate the effects of accessible web CMS tools and accessibility awareness on novice users with respect to achieving outcomes associated with accessibility of web content. To this end, an appropriate method that involved the collection of both qualitative and quantitative data was required to address the research questions. The following section outlines the methods selected and used in the final research.

3.1.1 Research Methods

In any field of research, there are numerous research methods that may be used in isolation or in combination to collect usable data. Williamson and Johansen (2013) name nine that may be applied to studies, while other authors have designated various methods that may be applied to specific areas (sociology, psychology, economy, management, and so forth). From the abundance of methods available, this research utilised a mixed methods approach, incorporating elements of experimental research, survey research and observational research.

3.1.1.1 Experimental research

Experimental research is conducted to collect data about cause and effect and to observe the changes and consequences related to predefined dependent and independent variables (Walliman, 2011). Abraham and Wasserbauer (2006) state that ‘true experiments have the potential to provide strong evidence about the hypothesized causal relationship between independent and dependent variables. Experiments are characterized by manipulation, control, and randomization. The quality of experiments depends on the validity of their design’ (p. 185). In this method, the independent variables represent the inspected variables under the control of the researcher, while the dependent variables represent the results of the experiment (Miller, 1998). This type of research is typically used in a laboratory or controlled environment but may also be undertaken in almost any type of environment to expose groups to the experiment being conducted. Williamson and Johansen (2013) define two types of groups: the experimental group, which is exposed to the treatment, and the control group, which is not. Data are collected from the two groups, compared and statistically analysed. Depending upon the design of the research, pre-tests and post-tests can be performed for both groups to analyse the effectiveness of the treatment.

The limitations of experimental research lie in identifying results related to causal connections. Shadish, Cook and Campbell (2002) note that ‘the strength of experimentation is its ability to illuminate causal inference. The weakness of experimentation is doubt about the extent to which that causal relationship generalizes’ (p. 19), Royne (2008) adds that the compromise between internal and external validity in experimental design may be the paramount issue, explaining that a good design ensures causality but ‘when strong internal validity exists by maintaining this tight control, the realism decreases, and consequently, the findings from the experiment are not easily generalized to other situations’ (p. 2). Abraham and Wasserbauer (2006) argue that validity is ‘a matter of degree, determined by the extent to which the researcher has tried to cope with the various potential threats to each type of validity’ (pp. 186–187). In this study, participants were asked to undertake, to varying degrees, a ‘crash course’ in accessibility awareness before implementing a selection of accessibility principles in a web CMS environment. Such activity is not unusual in a corporate setting, although the limited timeline and the focus on a specific selection of WCAG 2.0 techniques may be considered an artificial construct that would not typically take place in a real-world setting. For these reasons, a different research method was considered to offset the limitations of this method to some degree and to gain a participant view of the tasks they were being asked to undertake.

3.1.1.2 Survey research

Survey research is a method of data collection through various modes (Donley & Grauerholz, 2012; Walliman, 2011). It involves collecting information from a sample or an entire population that is used to interpret, clarify or explain certain features (such as results from experimental studies). Williamson (2013) notes that 'surveys gather data that describe and explain population or simple characteristics, behaviours, attitudes or opinions and may be used to predict future behaviour' (p. 142).

Survey research uses different methods that have evolved from group-administered surveys (Donley & Grauerholz, 2012) to those based on paper forms and telephone surveying. In the late 1990s, new technologies brought advanced delivery methods. Online surveys (email or web-based) have mostly taken over from manual printed approaches and surveys are now primarily delivered via web browsers and mobile devices (Williamson, 2013). Williamson (2013) states that this change has occurred because of the benefits gained, including the reduction in expenses and time taken to administer survey instruments and the improvement in participant response rates. However, Donley and Grauerholz (2012) indicate that modern survey techniques, including phone- and web-based surveys, may be limited by participant access to (and cost of using) telephone and web technologies, which could lead to a reduction in participation rates. These possible limitations have led researchers to adopt other methods depending on their research aims and the effectiveness of those methods in their research context.

3.1.1.3 Observational research

Observational research is non-experimental and involves observation of participants' actions and behaviour (Clow & James, 2014). In the social sciences, there are two types of observational research: systematic or structured observation, which is associated with social psychology, and participant observation, which is typically related to sociology and anthropology (Denscombe, 2014). Both methods share similar characteristics because they each rely on direct observation, collect data from real settings and recognise the possible issue of researcher perceptions.

In structured observation, as the name implies, researchers may structure the working environment and limit behaviours for which they are gathering quantitative data, which supports this approach in terms of gains and time benefits. However, the drawback is that by controlling the setting, external validity may be compromised (Denscombe, 2014). Conversely, participant observation involves observing participant behaviours in their natural settings. The researcher becomes an active member of the group but can choose to hide or reveal his or her identity. This approach has the benefit of providing better understanding for the researcher but has the potential to influence participants' behaviour (Price, Jhangiani, Ciang, Leighton, & Cuttler, 2017).

In observational research, the observation method, also named participant observation, ethnography or merely observation (Baker, 2006), is used as a method of observing and collecting data and recording participants' actions and behaviour (Center for Innovation in Research and Teaching, n.d.). It is considered a research method, a data collection method (cited in Baker, 2006) and a participatory study because it involves the researcher's participation in the natural research environment when recording or observing (Baker, 2006). According to Jorgensen (1989):

> The methodology of participant observation is appropriate for studies of almost every aspect of human existence. Through participant observation, it is possible to describe what goes on, who or what is involved, when and where things happen, how they occur, and why—at least from the standpoint of participants—things happen as they do in particular situations. The methodology of participant observation is exceptional for studying processes, relationships among people and events, the organization of people and events, continuities over time, and patterns, as well as the immediate sociocultural contexts in which human existence unfolds. (p. 12)

Participant involvement depends on the role of the researcher, who may be a complete observer, observer as participant, participant as observer or complete participant. A complete observer is a passive and detached observer whose presence is limited to listening to the group (cited in Baker, 2006), which has the disadvantage of missing some information from the group's conversation. Similarly, the observer as participant is more an observer and has limited relations with the group, which influences the researcher's broad knowledge of the situation. In the role of participant as observer, the researcher has greater involvement with participants and becomes an active member (Baker, 2006), which can negatively influence the researcher's objectivity. When the researcher has a complete participation role, he or she becomes a part of the group, enabling a greater understanding of participants. However, this role may lead to obstruction of the findings if the researcher feels that he or she has violated the assigned role (Baker, 2006).

Besides the human method in which humans observe humans, there are two other methods of observation: mechanical and online. According to Clow and James (Clow & James, 2014), human actions and behaviours may be tracked using numerous devices in mechanical observation or with the use of web metrics or other online mediums. Mechanical methods have the advantage of being more accurate and efficient in measuring the studied phenomena, while online observation is recognised for its prominent presence on the internet, with a potential for high participation from users of the web, providing easy access with low cost and quicker data collection and tracking.

3.1.1.4 Mixed methods research

Mixed methods research, as its name infers, is a mix of qualitative and quantitative methods in a single study (Biddle & Schafft, 2014). This combination of methods can assist research outcomes as it merges qualitative and quantitative results to create a more holistic set of data for researchers to analyse (Bergman, 2008). Data collected from various sources can lead to a triangulation approach, seeking convergence between qualitative and quantitative methods (Wilson, 2006) that should be paired rather than viewed as competing (Jick, 1979). Jick (1979) lists the benefits of triangulation of methods:

- Contributes to providing additional information to the research problem
- Integrates or combines theories
- Produces 'holistic works' that encompass important characteristics (precision and information consistency). (pp 2-3)

Jick (1979) identifies the drawbacks of triangulation as time, cost and lack of easy replication of results, although he believes that the benefits of triangulation overcome such issues:

> It heightens qualitative methods to their deserved prominence and, at the same time, demonstrates that quantitative methods can and should be utilized in complementary fashion. Above all, triangulation demands creativity from its user ingenuity in collecting data and insightful interpretation of data. (p. 10)

3.1.2 Selected Research Methodologies

The three methods discussed in the previous section (experimental, survey and observational) were selected for this research as they were well-suited to this study, which aimed to compare data collected from two groups, AAG and AUG, using a compliant web CMS tool, with one group exposed to an accessibility awareness training session. Along with the use of the selected web CMS tool to develop a website, participants were asked to complete pre- and post-tests as well as a web-based survey. Quantitative and qualitative data were combined into an overall mixed methods approach, ensuring data convergence and triangulation.

3.1.3 Mapping the Research Questions to Methods

This study was conducted using an overarching mixed methods approach with experimental and survey methods associated with the primary data collection processes. These methods helped to address the overarching research question and the three supporting questions. Figure 3.1, based in part on the thesis research design of (Brown, 2005), displays the relationship between the experimental and survey methods and the data they provided to support and analyse the research questions. In both groups, the participants performed different activities required for this research.

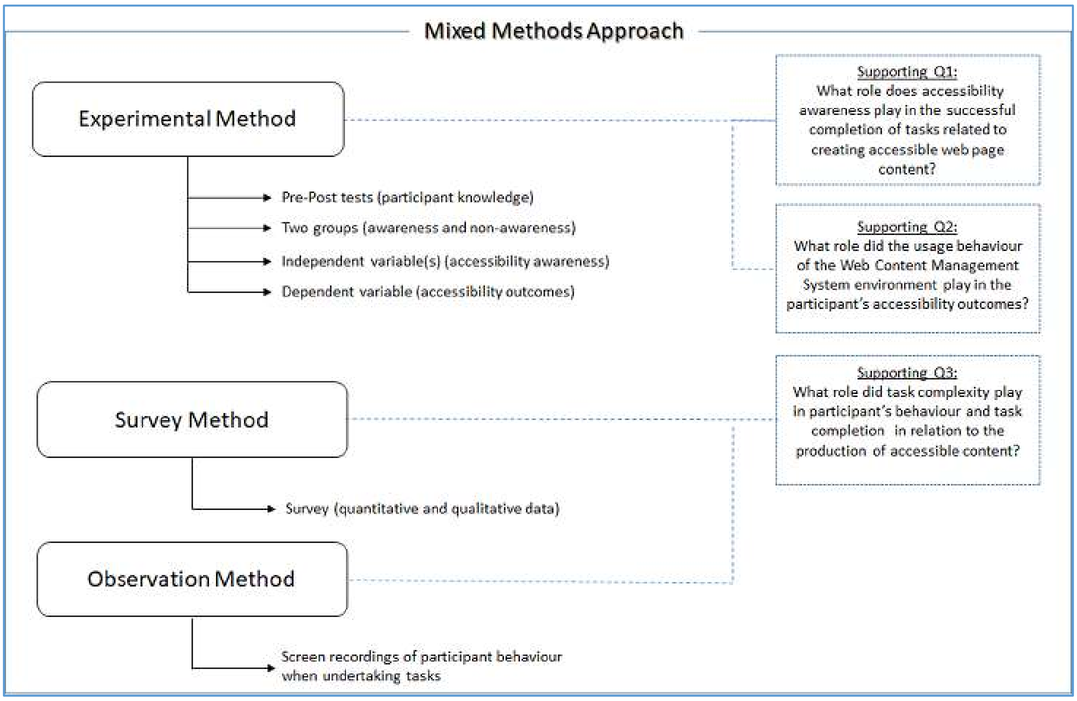


Figure 3.1: Mapping of research methods to questions

Summary of the research activities

Before engaging in the research activities, the researcher provided participants with a concise description of the training session, i.e. time required and how to access the instruments. Participants firstly signed the consent form (see Appendix D) then received individual identification to use with all the research instruments.

Pre- and Post-Test:

The participants in the AAG and the AUG started the awareness training session with the online pre-test. As described in section 3.2.2.1.1 “Pre- and post-test instrument design”, the pre-test’ responses reflected the participant’s existing knowledge to the session while the post-test responses reflected changes that occurred as outcomes of the session. For both tests, the participants answered questions, in a similar order to ascertain the progress they had made from pre- to post-tests and provide the performance information between both participant groups. The set of questions were organised under four sections:

- Web and Accessibility to know the participants ‘general knowledge about web accessibility.
- HyperText Markup Language (HTML) to discern the participants’ skills as to their understanding of elementary HTML.

- W3C to identify the participants 'perception of the organisation and what its role is in terms of web accessibility.
- Web Content Management Systems (WCMS) to determine the participants' knowledge level of Web CMS tools.

The experimental phase of the research provided mainly quantitative data that required some qualitative interpretation (such as determining some aspects of accessibility outcomes), whereas the survey data provided information used in the interpretation of some experimental data (e.g. why participants did what they did).

As the research design below demonstrates, participants in this study were asked to perform a series of tasks in the selected Web CMS environment, the outcomes of which dictated the accessibility outcomes for the dependent variable.

The survey aspect of this research asked the participants to describe their use and understanding of the web CMS environment to provide some insight on the influence this had on specific accessibility outcomes. Figure 3.2 shows the triangulation of methods used for this research and how they interacted to provide the data collected for analysis.

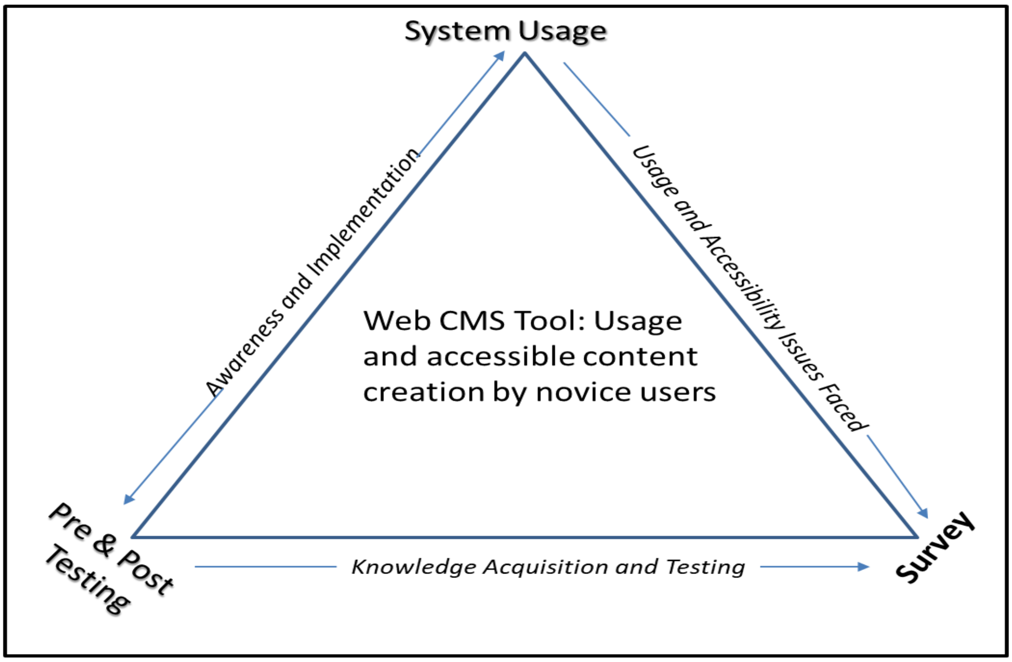


Figure 3.2: Research triangulation and data collection

3.2 Research Design

This section presents the overall design and the different phases of this research. The final study was preceded by a pilot study aimed at improving the quality of design and at addressing potential errors in the preliminary instruments to improve reliability and accuracy of the main study.

3.2.1 Global Research Design

In the research process, design is a procedure used to select methods and to develop instruments to address the research problem. The quality of the study and the generalisation of results depend on the methodological decisions made in the design process (Whittemore & Melkus, 2016). The research design is the leading category from which everything flows for the selections made (Vogt, Gardner, & Haeffele, 2012). It also 'refers to the plan of action that links the philosophical assumptions to specific methods' (Creswell & Crotty, as cited in Creswell & Plano Clark, 2007, p. 4). These assumptions guide the course of collection and combination of quantitative and qualitative data in various phases of the research process (Creswell & Plano Clark, 2007). In the design phase of this study, as illustrated in Figure 3.3, a two-group approach was adopted as part of the experimental design, with the AAG receiving some accessibility awareness training on the various concepts and features needed for the study, and the AUG not being exposed to the accessibility awareness training.

All participants were first exposed to a pre-test to ascertain their prior knowledge of basic HTML, web technology and accessibility. Following the pre-test, participants were assigned to two categories—those who demonstrated some basic HTML skills and those with little or no identifiable HTML skills. A randomised number was generated and allocated to each participant in each of these categories. Participants were then assigned to either the AUG or the AAG. Hence, participants in both the AAG and the AUG included those who knew basic HTML and those who did not know basic HTML.

Once the participants were assigned to groups, each group received a presentation prior to the development of the websites and the implementation of associated accessibility tasks with additional training material provided to the AAG (See Appendix B: Awareness Session Presentation). The researcher created the awareness-raising presentation, based on the items of the different instruments and the aim of the study. The final version of the presentation for the content and learning objectives of the session, with the participants, specifically those in the AAG being aware of the implementation of accessible features aiming to make online content accessible for everyone. For both groups, the presentation focused on general knowledge on web accessibility and its components beside web CMSs, while for the AAG only, additional content was added for the training purpose, i.e. HTML accessible elements for the website content. The researcher was also responsible for the awareness training session held in a class setting for each group.

All participants were then asked to perform a series of content-related tasks using the allocated web CMS, WordPress, after which they sat a post-test to identify any changes in their web technology and accessibility knowledge. Finally, participants completed a web-based survey, which contained questions regarding their use of the web CMS and the process involved in completing their assigned tasks. The research design outlined in Figure 3.3 was tested in a pilot study, which checked the viability of the methods, tools, web tasks and delivery of research instruments.

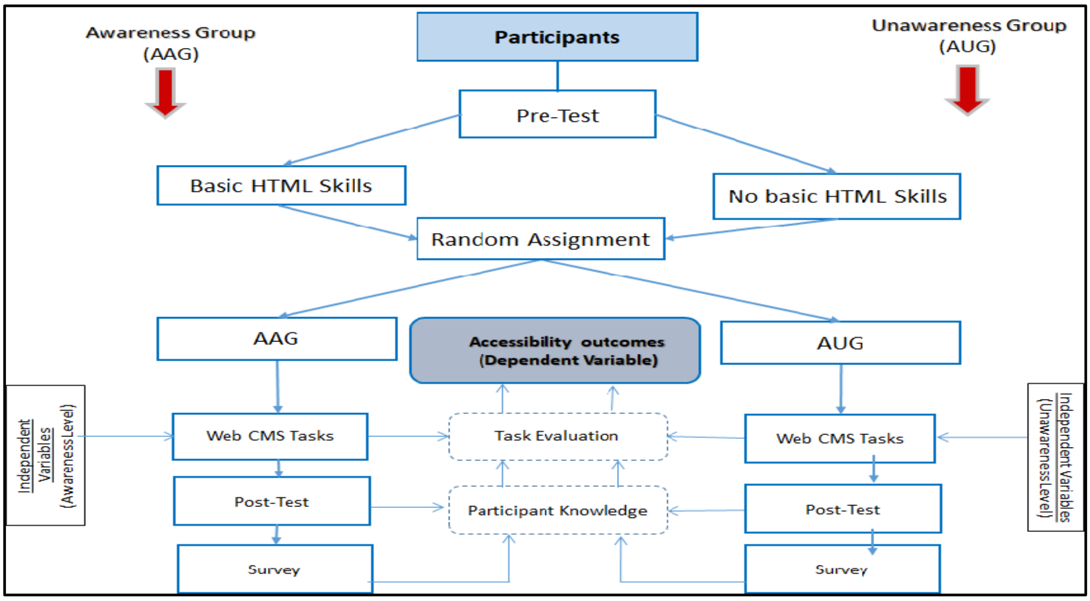


Figure 3.3: Research overall design

3.2.2 Research Phases

The research was conducted in three phases, as shown in Figure 3.4.

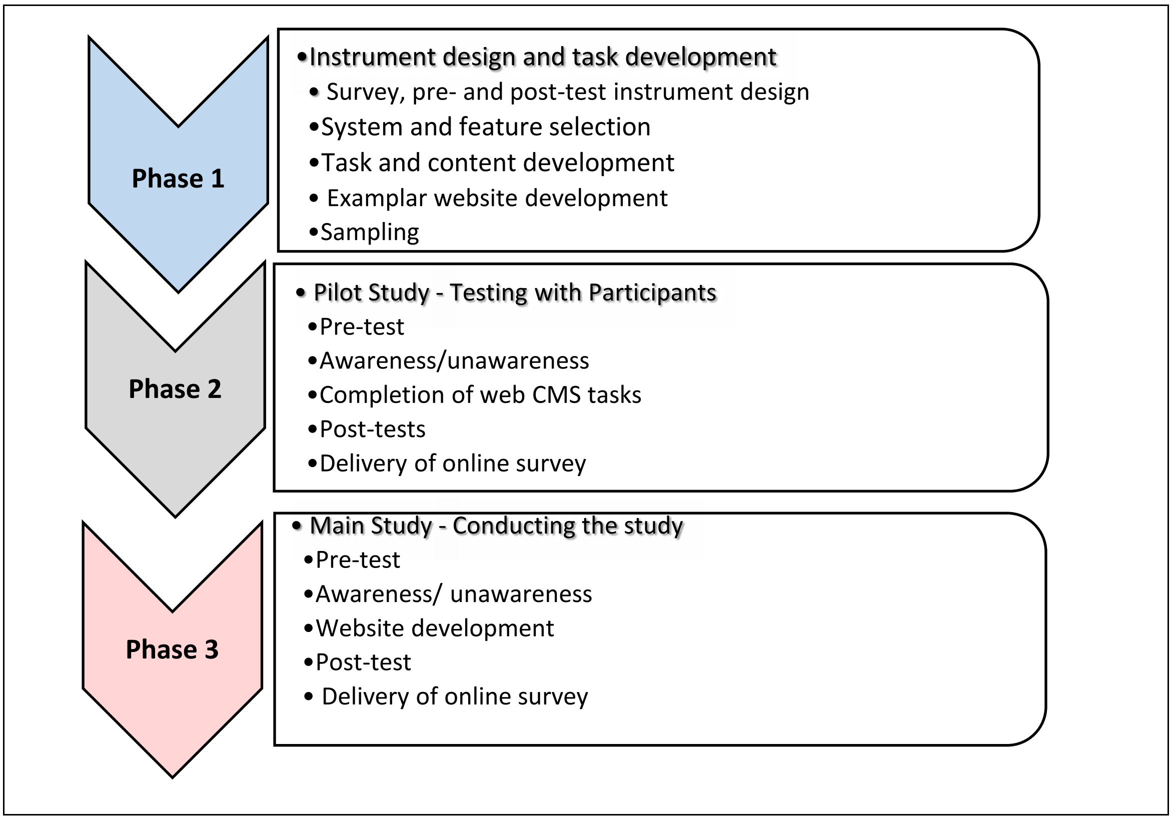


Figure 3.4: Research phases

3.2.2.1 Phase 1: Instrument design and task development

Prior to designing the questionnaires used to collect data, different types of questions used in the three online based instruments—survey, pre- and post-tests—were selected to conform to the original research design. The examples provided in this section are derived from the questionnaires developed for this study.

The first common type of question used was closed questions (illustrated in Figure 3.5). Closed questions include predefined responses such as yes/no or other options from which only one response can be selected. Because of the limited set of responses, this type of question has the advantage of being simple to answer, code and manage and allows the inclusion of multiple questions because the answers require less time for participants (Ayiro, 2012). Questions must be written with care because they can introduce bias if there is a predisposition to systematically select answers in the same way. In this research, the closed questions used in the questionaries, as in Figure 3.5, were designed to be reliable and precise to provide appropriate answers related to the aim of this research.

Q 1.1. Please specify your gender

- ○ Male (1)
- ○ Female (2)

Figure 3.5: Example of closed question

The second type of question used in this research were partially open-ended questions, illustrated in Figure 3.6. These are similar to closed questions, but predefined responses have an additional 'other' field for participants to supplement their explanation if none of the other answers are relevant (Jackson, 2015). This type of question was used twice in the web-based survey—once when asking participants about their self-evaluation on web use and again when asking participants to provide their opinion on the use of web accessibility.

Q 2.4. When do you think web accessibility should be considered?

- ○ All the time (1)
- ○ When it is required (2)
- ○ Not considered at all (3)
- ○ I don't know (4)
- ○ Other (please specify) (5) ____

Figure 3.6: Example of partially open-ended question

Open-ended or free-response questions, as seen in Figure 3.7, was the third type of question used in this research. This refers to questions that have no predetermined responses but for which the participants provide answers in their own words (Brace, 2008). The advantage of this type of question, despite its difficulties for coding and analysis, is that it allows new information on topics that have limited existing information (Ayiro, 2012). Given the design approach of the study, this type of question was used to provide qualitative data to complete the information obtained from the other types of questions (e.g. closed questions).

Q 4.2. From your understanding, what is the benefit of using a web CMS for managing web content?

____

____

____

____

Figure 3.7: Example of open-ended question

The fourth question type considered for the three instruments of this research was the multiple-choice question (MCQ) with an 'other' option, as shown in Figure 3.8. In this category of questions, participants could select one or more responses from the predefined answers provided as well as adding a response in the 'other' option. The advantage of MCQs is that they are simple to analyse and are free from errors because they are created by the researcher; however, they have some drawbacks because they are challenging to construct and need time to develop to be clear, precise and useful.

Q 1.2. What category of disability did you become familiar with?

- ○ Physical (1)
- ○ Hearing (2)
- ○ Visual (3)
- ○ Cognitive (4)
- ○ Leaning impairment (5)
- ○ Other (please specify) ____________________________ (6)

Figure 3.8: Example of multiple-choice question

The fifth type of question used in the web-based survey was the 'drag and drop' MCQ, as illustrated in Figure 3.9. This category of questions allowed the participants to order their preferences (QuestionPro, 2019). The options provided to participants were related to the structure and features selected to rank the difficulties perceived in ascendant order.

Q 3.6. Which function did you find was the most difficult to understand? (Please rank from the most to the least by dragging and dropping the mouse down or up)

______ Headings (1)

______ Links (2)

______ Videos (3)

______ Tables (4)

______ Structure (5)

Figure 3.9: Example of drag and drop multiple-choice question

The last type of question used in the web-based survey questionnaire was based on the Likert scale, as illustrated in Figure 3.10. The Likert scale can be used to measure opinions and attitudes and bring a level of nuance to the central research question. Responses may be analysed as a single item when items are aggregated or averaged. According to Brill (2008):

> The Likert scale, named for Rensis Likert (pronounced "Lick-urt") who published a seminal report describing its use, possibly it is the most employed form of attitude measurement in survey research. Similar to nearly all psychometric scale measures, the Likert scale consists of multiple items that typically are summed or averaged to produce a more reliable measure than could be obtained by use of a single item. (p. 428)

In this research, the Likert response set included five points: strongly disagree, disagree, neutral (i.e. neither agree nor disagree), agree and strongly agree. Because this study aimed to compare the two groups, this method was used for both groups to understand the attitudes of each towards the tools used, time allocated, environment and the participants' expectations from the awareness session.

Q 5.5. What do you think about the training environment (i.e. room and delivery process)?

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Agreeable (1)					
Appropriate (2)					
Unsuitable (3)					

Figure 3.10: Example of Likert scale question

In general, the various types of questions used in this research were selected to provide answers or viewpoints of the participants in this study. Besides the closed questions used in the three instruments (survey, pre- and post-tests), some items were designed to obtain complete responses (e.g. MCQ with 'other' option), while others added new information on the subject (e.g. open-ended questions) or provided information to measure participants' attitudes towards the awareness session tools (e.g. Likert scale questions). These items were the main components of the web-based survey and the pre- and post-test questionnaires.

To fulfil the aims of this study, quantitative and qualitative data were collected using questionnaires, which was perceived as the most effective way to collect data. According to McNeill and Chapman (2005), a questionnaire is 'a list of questions to be asked by the researcher. It is prepared in such a manner that the questions are asked in exactly the same way of every respondent' (p. 33). Therefore, the preparation of questionnaires focused on several elements to conform to the desired outcome of the research. Content should consider the elements related to the target population, the characteristics of participants, the items to consider, question type, key study variables and all other elements to enhance clarity, relevance and usefulness of these components to the research.

3.2.2.1.1 Pre- and post-test instrument design

The design of the pre- and post-test instruments (see Appendix A) included consideration of all necessary elements, allowing the gathering of data regarding the participants' level of knowledge and skill with respect to the common themes of this study (see Figure 3.11). Apart from three questions that were excluded from the post-test instrument because they would have elicited redundant information. Both tests included the same questions. Questions were related to participants' involvement in web accessibility (Q1.1), occupation (Q1.2), previous web CMS use and tasks completed (Q4.4). The aim of having similar questions in both instruments was to detect improvements following the awareness session, to compare the performance of AAG and AUG and to measure the effects of training on the AAG.

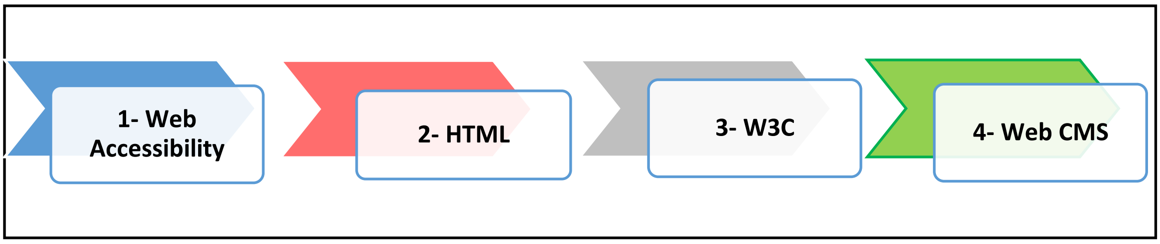


Figure 3.11: Pre- and post-test instrument structure and themes

Questions included in the instruments (23 in the pre-test and 20 in the post-test) were designed with caution. Questions on the same topic were grouped to avoid confusion and ambiguity and to help participants focus on one topic at a time. For example, under the web and accessibility section, questions were related only to this topic (see Table 3).

Table 3.1: Items in web and accessibility section in pre- and post-tests

Q. 1.1	Are you involved in web accessibility (i.e. developer, tester, auditor, etc.)?
Q. 1.2	If you are employed full-time or part-time? Could you briefly describe your occupation?
Q. 1.3	What does the term web accessibility mean to you?
Q. 1.4	What categories of disability are you familiar with?
Q. 1.5	Do you know the term that is used to describe technologies that allow people with disabilities to use the web?

All questions used in this research, for the three instruments (Pre- Post-test, survey), were developed and reviewed based on different items in various studies. After selecting several questions, some were rejected, and others kept and adjusted to the current study; the selection of the remaining questions –with the assistance of a statistician– was based on the credibility, accuracy, clarity, feasibility and distinctiveness (Berger et al., 2014; Foddy, 1993). Based on the results from the pilot study, the revision of the structure, understanding, flow of the questions, redundancy and outcomes from the questions were considered and finalised. The feedback allowed gauging what the participants knew about accessibility, and thus, what they would learn from the awareness raising and web tasks. Overall, the instruments were designed to be test 'basic' knowledge as the expectation for this study was that the participants would primarily be 'novices'.

In Section 1, participants were asked to enter their unique six-digit identification number (Figure 3.12). This was to guarantee anonymity, to allow the researcher to identify individual records when exporting data and to link the records of each participant from the three instruments and the recording tool of this research.

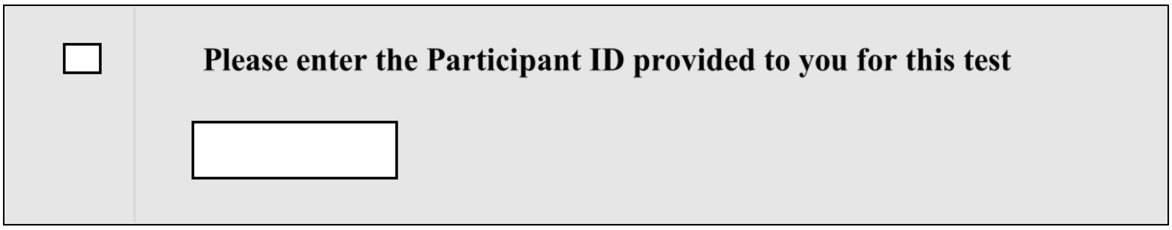


Figure 3.12: Participant identification in pre- and post-test questionnaires

Each questionnaire section was introduced with a brief explanation of the aim and context of the section (see Figure 3.13). All participants in both groups, AAG and AUG, were asked about their involvement in any activity in web accessibility—this was essential for the remainder of the section because it allowed a link to be made between the degree of knowledge and accessibility awareness and how people involved in development perceived and understood accessibility concepts.

Figure 3.13: Example of question related to involvement in web accessibility

As discussed in the literature review, web accessibility, even for experts in the field, has different meanings for different people with divergent views (Brajnik, 2011; Grantham et al., 2012; Persson et al., 2015; Yesilada et al., 2012). Based on this, one question (shown in Figure 3.14) aimed to elicit participants' definition of web accessibility.

Figure 3.14: Example of question related to the definition of web accessibility

Participants were asked about the categories of disability with which they were familiar (see Figure 3.15). Because this concept was discussed in the presentation for all participants, participants from both groups (AAG and AUG) were invited to add categories for the purpose of identifying and comparing knowledge levels regarding web accessibility following the awareness session.

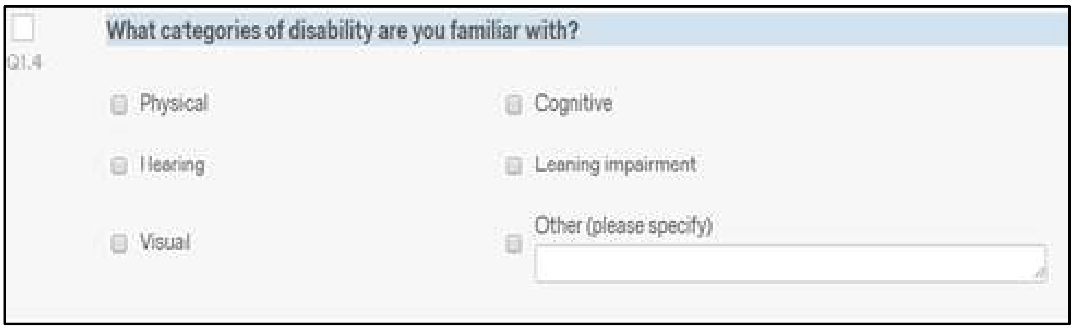


Figure 3.15: Example of question related to categories of disability

Section 2 sought to identify participants' HTML skills (see Figure 3.16). The first five questions in Section 2 of the pre- and post-test questionnaires were designed to elicit information about basic HTML skills, while the remainder were designed to elicit information about intermediate HTML skills. All 10 questions of this section were used to establish a list of HTML skills (see Figure 3.3).

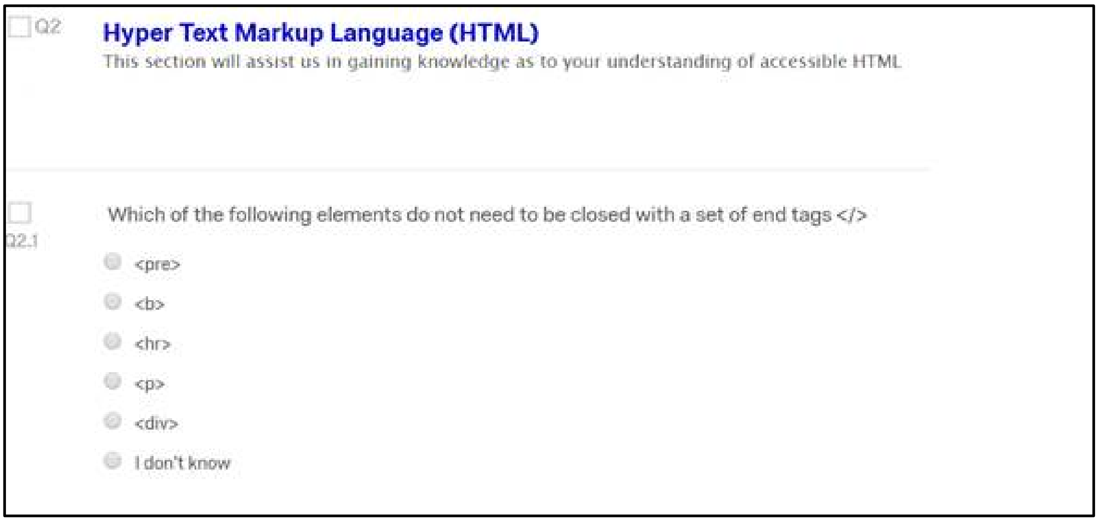


Figure 3.16: Example of question related to HTML skills

Heading tags (H1 to H6) are developed in HTML to provide a logical structure for web page content and to facilitate navigation for users of assistive technologies. According to WebAIM (2013b):

> When encountering a lengthy web page, sighted users often scroll the page quickly and look for big, bold text (headings) to get an idea of the structure and content of the page. Screen reader and other assistive technology users also have the ability to navigate web pages by heading structure, assuming true headings are used (as opposed to text that is styled to be big and/or bold). This means that the user can view a list of all of the headings on the page, or can read or jump by headings, or even navigate directly to top level headings (<h1>), next level headings (<h2>), third level headings (<h3>), and so on. (para. 5)

Based on this, the questions in this section (see example in Figure 3.17) were designed to evaluate participant skills before and after the awareness session, particularly for AUG participants who were trained on these elements, and to assess improvement and the effects of accessibility awareness training on the ability of AAG participants to add headings to web page content.


Q2.4 Which of the following do you think is an example of accessible HTML for the headings?

- <h1>Hello everybody</h1>
  <h2>Hello everybody</h2>
  <h3>Hello everybody</h3>
- <h2>Hello everybody</h2>
  <h1>Hello everybody</h3>
  <h3>Hello everybody</h1>
- <h2>Hello everybody</h3>
  <h1>Hello everybody</h2>
  <h3>Hello everybody</h1>
- None on the above
- I don't know

Figure 3.17: Example of question related to accessible HTML for headings

The web has grown considerably and has become a daily medium used worldwide. Its protocols, standards, guidelines, and specifications for HTML and have been determined and developed by the W3C group (WebAIM, 2013d). This critical work to make web content accessible to all users is internationally recognised. The question shown in Figure 3.18 was designed to identify how well this organisation was known by participants in this study, who were users of the web. Similar to other questions in Section 3 in the pre- and post-test questionnaires, the question was designed to evaluate the effects of the awareness session for all participants.


Q3 W3C
This section will allow us to understand your knowledge of the W3C

Q3.1 What does the acronym W3C stand for?

- The Web Wide Web Conglomeration
- The World Wide Web Consortium
- The World Web Wide Confederation
- I don't know

Figure 3.18: Example of question related to the W3C acronym

Participants were also asked to identify the meaning of the acronym WCAG (see Figure 3.19), which was developed by W3C in conjunction with joint work and effort of individuals and corporations worldwide:

> Web Content Accessibility Guidelines (WCAG) is developed through the W3C process in cooperation with individuals and organizations around the world, with a goal of providing a single shared standard for web content accessibility that meets the needs of individuals, organizations, and governments internationally. (W3C, 2018d, para.1)

Apart from comparing knowledge before and after the awareness session, the aim of this question was to ascertain participant familiarity with the guidelines and the organisation that developed them—in other words, how their subconscious knowledge may have helped in developing accessible content.

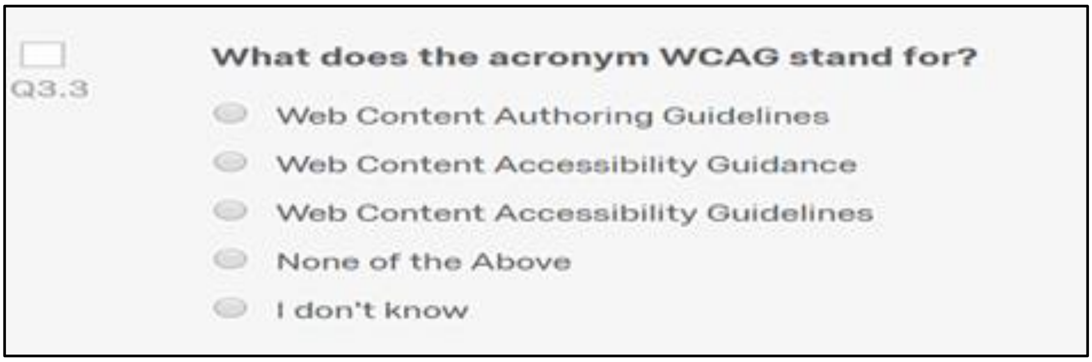


Figure 3.19: Example of question related to WCAG acronym

Section 4 focused on web CMSs. Participants in both AAG and AUG were asked if they were familiar with these systems—those who were may have had higher expectations of the role and use of web CMSs, which may have affected outcomes.

Figure 3.20: Example of question related to web CMSs

Only those participants who answered that they had heard of web CMSs were asked to list three of these systems. This question aimed to ascertain knowledge about web CMSs, the systems participants were familiar with and whether they had the skills to differentiate between web CMSs and other tools.

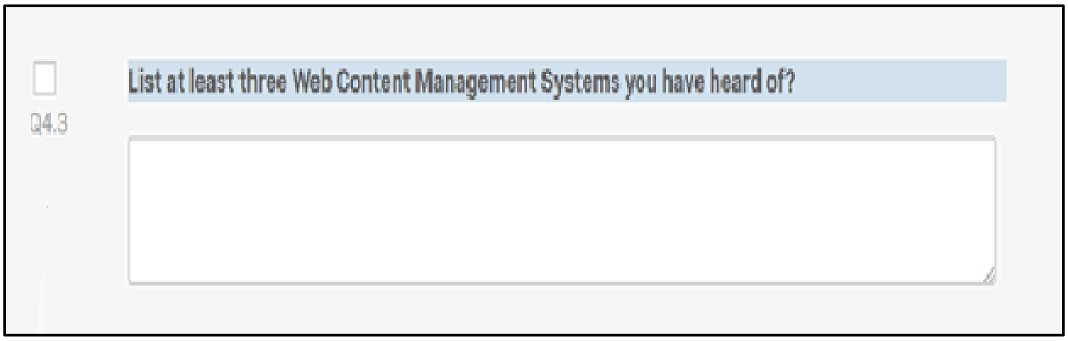


Figure 3.21: Example of question related to web CMSs familiar to participants

To sum up, pre- and post-test instruments were designed to compare measures of participant knowledge before and after the awareness session. As questions and procedures were identical for both instruments, a difference in scores allowed a comparison to made and illustrated participant progress in knowledge and the effects of the awareness session training on improvements.

3.2.2.1.2 Survey instrument design

Questionnaires are a list of questions developed by a researcher to gather data from participants in a study. Surveys may be distributed in various ways, including online (as in the case of this study—see Appendix A), by post or through newspapers or magazines (Brace, 2008; McNeill & Chapman, 2005).

Designing an online questionnaire is challenging because it requires considerations about the type of question (open, closed, multiple-choice, Likert scale, etc.), instructions (directions to complete the questionnaire), layout (visual impression of various items), navigation (e.g. buttons, progress bars or links), response format (e.g. buttons, menus or boxes) and formatting (e.g. colours, graphics and text appearance) (Ritter & Sue, 2007) as well as other techniques used to increase readability (e.g. magnifiers and highlighters). According to the Pew Research Center (2019):

> Questionnaire design is a multistage process that requires attention to many details at once. Designing the questionnaire is complicated because surveys can ask about topics in varying degrees of detail, questions can be asked in different ways, and questions asked earlier in a survey may influence how people respond to later questions. (para. 2)

In this research, an online survey questionnaire was developed following design techniques, layout and structure using a logical hierarchy that grouped questions under specific sections, as shown in Figure 3.22. Each section had various questions types and structures, depending on the topic. Section 1 collected general information from participants and information about their experience and use of the web; Section 2 identified participants' knowledge and opinions about web accessibility; Section 3 gathered information on participant familiarity with accessibility guidelines; Section 4 gathered information on participants' experience and use of WordPress; and Section 5 gathered feedback, opinions and suggestions of participants regarding the awareness session.

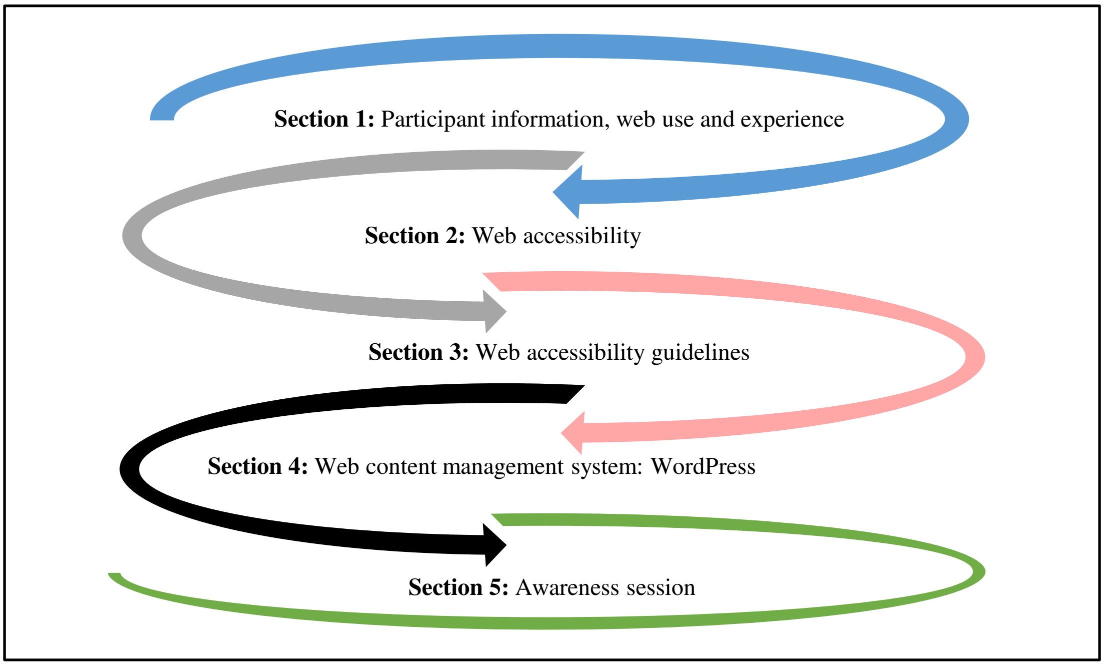


Figure 3.22: Survey instrument structure

Each topic was designed in such a way that it encompassed questions specific to that topic. Each participant was asked to provide their unique allocated number (see Figure 3.23) before being guided through the survey with instructions and a brief explanation of each section. They were assured that records would be kept anonymous and that no information would identify them in this thesis.

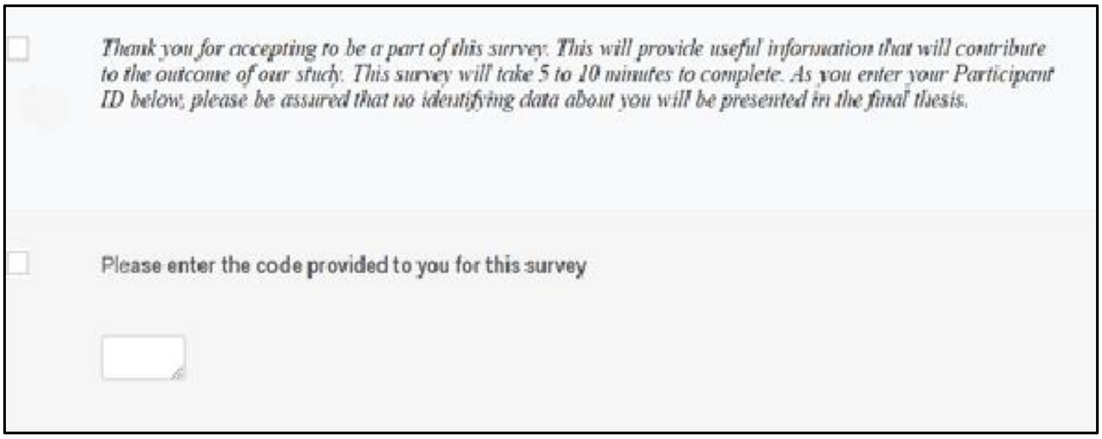


Figure 3.23: Participant identification in the web-based survey

In Section 1, participants were asked to provide demographic information, such as gender and age, and information on their experience and use of the web (period, purpose and experience level). These questions aimed to gather information prior to participant involvement in the research that may help explain their achievements. Figure 3.24 provides an example of a partially open-ended question, which provided data from either the structured responses or from the 'other' option.

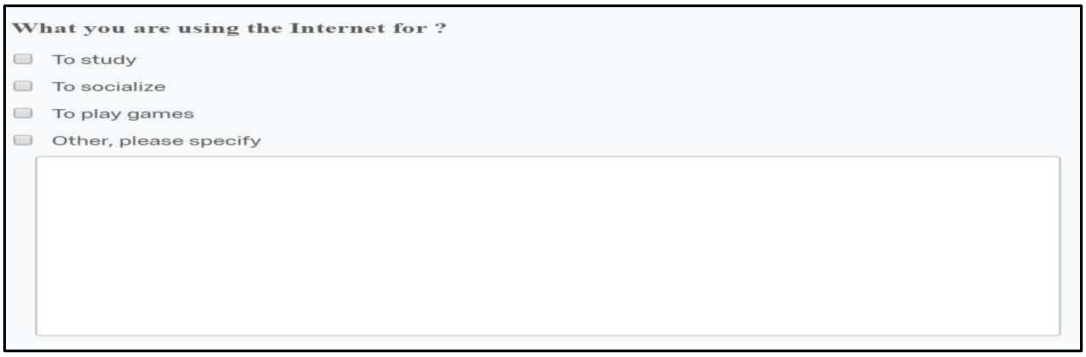
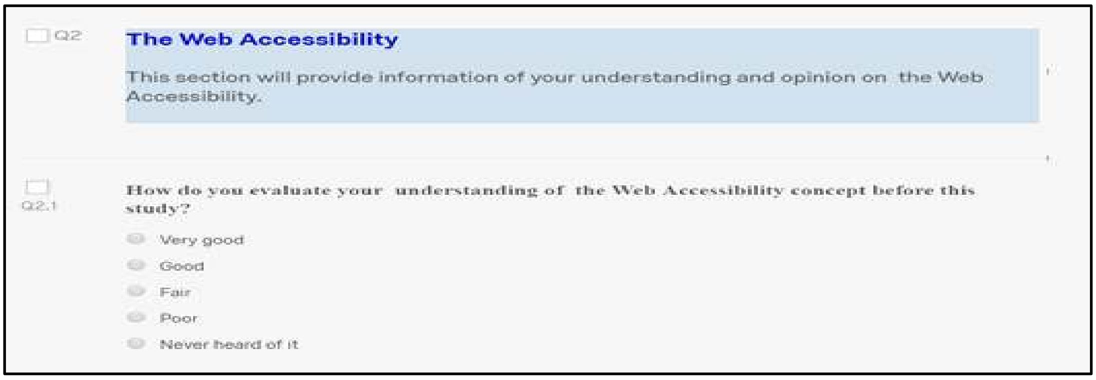


Figure 3.24: Example of question related to the purpose of internet use

In the second section, questions were designed to provide information about web accessibility and its use by participants in this research. The question shown in Figure 3.25 provided additional information elicited by Question 1.3 (in Figure 3.13) in the pre- and post-test instruments—it validated whether participants had answered correctly, because it would be irrational to evaluate their understanding of a concept they had never heard of prior to the study.



Q2

The Web Accessibility

This section will provide information of your understanding and opinion on the Web Accessibility.

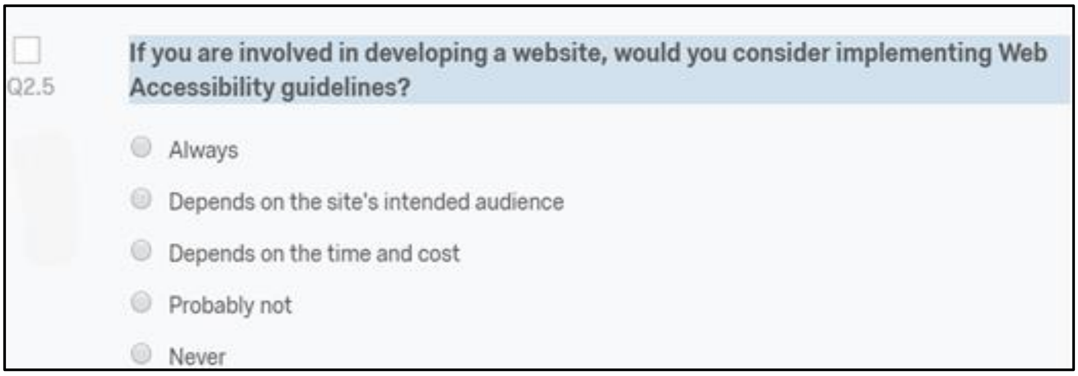
Q2.1

How do you evaluate your understanding of the Web Accessibility concept before this study?

- Very good
- Good
- Fair
- Poor
- Never heard of it

Figure 3.25: Example of question related to participant understanding of web accessibility prior to the study

The question shown in Figure 3.26 sought to determine the effects of the awareness session on the likelihood of participants, especially those in the AAG, implementing accessibility guidelines in their future website development. It helped to identify participants' commitment to accessibility and any changes in attitudes towards disability and people with special needs.



Q2.5

If you are involved in developing a website, would you consider implementing Web Accessibility guidelines?

- Always
- Depends on the site's intended audience
- Depends on the time and cost
- Probably not
- Never

Figure 3.26: Example of question related to the implementation of accessibility guidelines in future web development

In Section 3, the first question (Q3.1) was aimed at all participants to identify those who had participated in accessibility awareness training (i.e. AAG participants) (see Figure 3.27). All other questions in Section 3 were aimed only at participants from the AAG group.

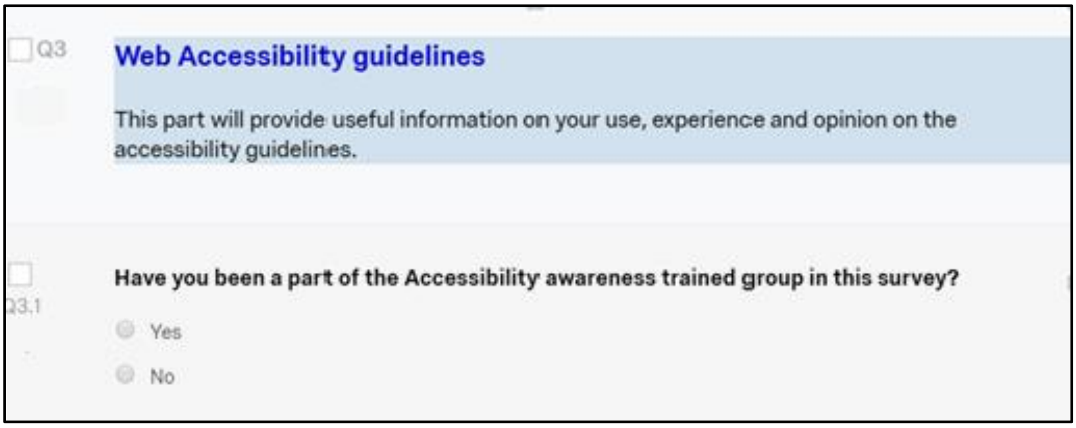


Figure 3.27: Example of question related to isolation of the awareness trained group

The question shown in Figure 3.28 was designed to determine the most complex tasks selected for this research. This information was crucial to identify difficulties, the reasons for not implementing accessibility components and the effects of these functions, once implemented, on outcomes.

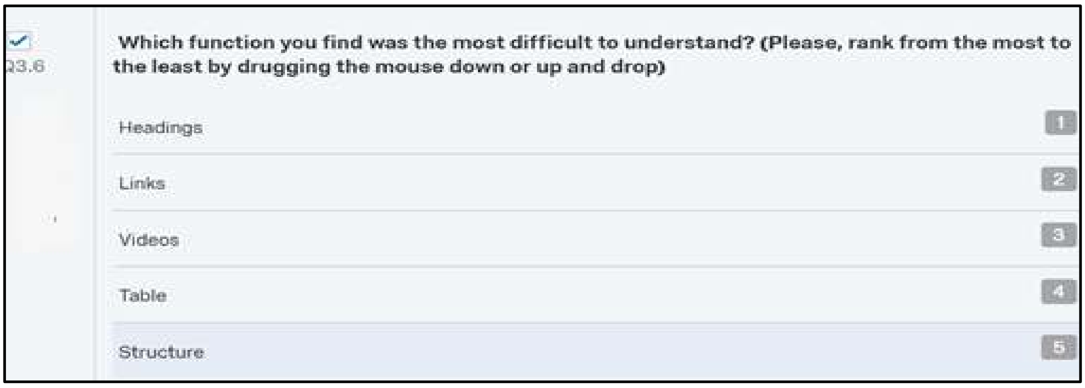


Figure 3. 28: Example of question related to the most difficult tasks

Section 4 was designed to gather information related to WordPress, which was the system used by participants in this research. Question 4.1 (shown in Figure 3.29) distinguished between participants who found WordPress difficult to use, those who found it easy to use and those who were unable to decide. Other questions were designed to identify these difficulties.

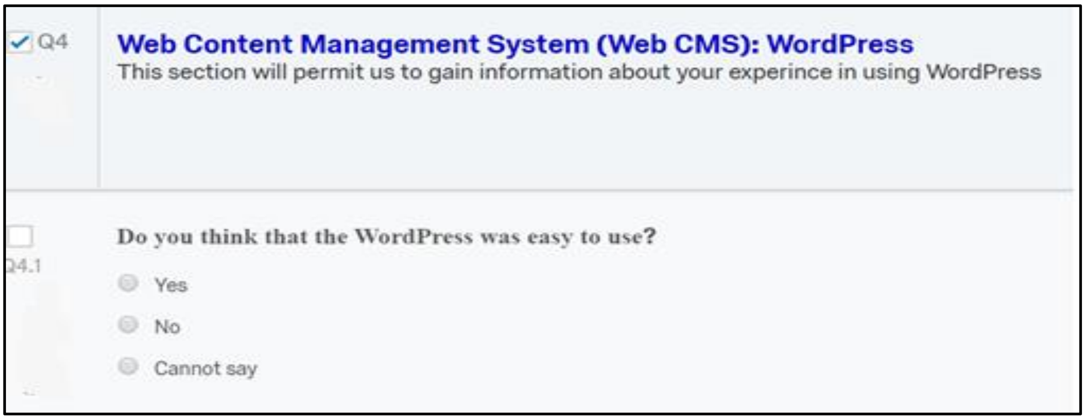


Figure 3.29: Example of question related to WordPress ease of use

The question shown in Figure 3.30 gathered information on participants' reasons for not applying the accessibility requirements of WordPress. Their feedback provided an understanding of the difficulties for novice users and how those users perceived accessibility in using the web CMS. Other questions requested more information regarding identification of accessibility options in WordPress, features participants liked and disliked and whether they would recommend it to others. These data were linked to data from the pre- and post-test instruments to obtain useful information for analysis.

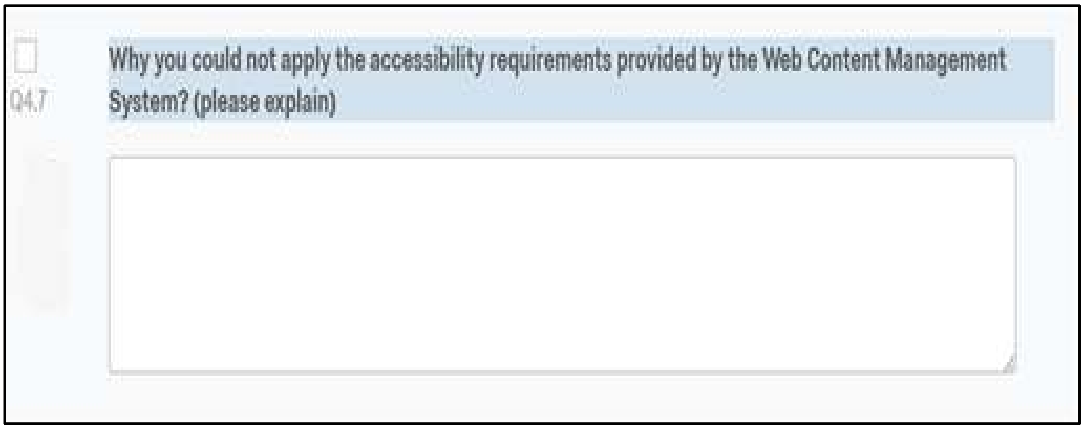


Figure 3.30: Example of question related to the cause of not applying the accessible requirements offered by the Web Content Management System

Apart from the final question (Q5.6), which asked for participant suggestions on improving accessibility awareness material, Section 5 used 5-point Likert scales to measure participant satisfaction, with options being:

- SD: Strongly disagree
- D: Disagree
- N: Neutral
- A: Agree
- SA: Strongly agree

Participants were asked to select from these pre-coded responses to express their opinions on how much they agreed or disagreed with statements about time (Figure 3.30), materials used, session environment and session expectations.

Overall, the design of the three instruments used in this research allowed for the collection of both qualitative and quantitative data based on both structured questions with predefined answers and open-ended questions.

Participant viewpoints provided additional valuable information that contributed to eliciting a set of data for discussion and analysis.

3.2.2.1.3 Web content management system selection

The selection of tools used in this research was based on various criteria and methods. Four elements were considered: the web CMS, its features, recording tools and content. For the web CMS, a systematic random sampling (discussed in Section 3.3.2) was conducted in such a way that each unit of the population (from the list of selected systems) had an equal chance of being part of the sample (Thompson, 2012). This type of sampling minimises sampling bias when it does not reflect the characteristics of the target population and makes it simple and straightforward to form a sample group from a large population. During this phase, the selection of an open-source system was based on various aspects, including provision of continuous support, frequent updates, cost effectiveness and extendibility.

There was a particular focus on selection of features during the design process. Consideration of the standard features used in websites for formatting, structure and layout was imperative. Features include fonts (family and size), colour, images (title, captions, alt text, descriptions), headings (<h1>, h2> and <h3>), lists, links, table and video features, all of which contribute to making content accessible. W3C provides detailed information about features in its technical documents. For example, Guideline

1.1.1: Non-text Content (W3C, 2018c) (Figure 3.31) provides an example of links between two documents, with one link explaining how to meet 1.1.1 and the other link explaining how to understand 1.1.1. Each of these are linked to an explanation of techniques for WCAG 2.0.

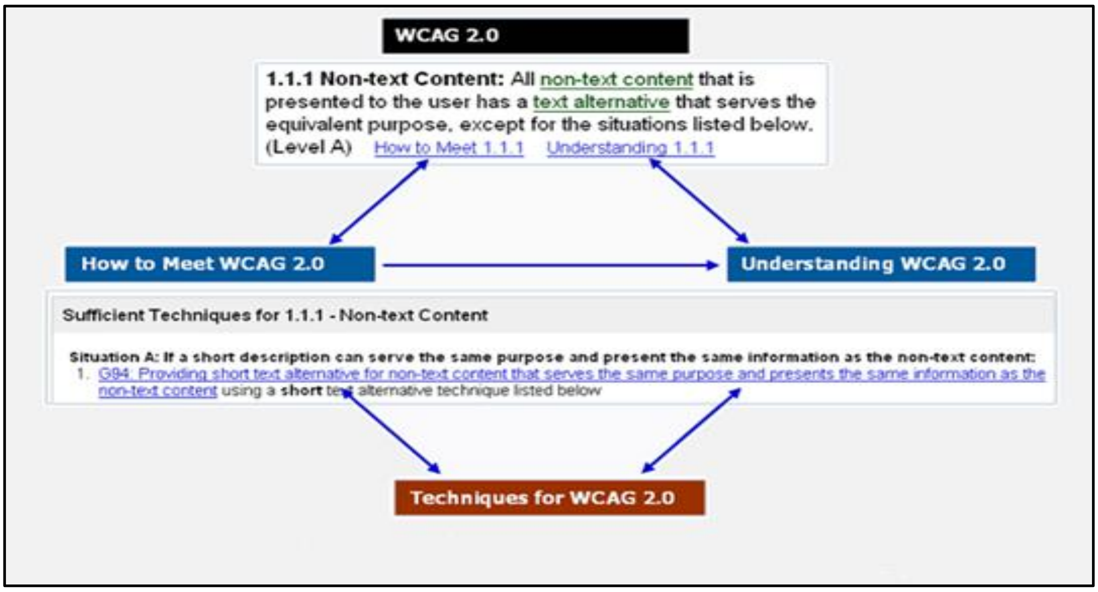


Figure 3.31: Example of links between documents(W3C, 2018c)

In W3C's quick reference guide, approximately 11 sufficient techniques (with 98 links for different situations) and 10 failures are provided for Success Criterion 1.1.1 (Non-text Content). Each of these situations is linked to a page with information about the techniques and an applicability section that 'explains the scope of the technique, and the presence of techniques for a specific technology does not imply that the technology can be used in all situations to create content that meets WCAG 2.0' (W3C, 2016e). In addition, W3C provides a description of the technique, examples of alt text, and available resources for the technique, test procedures and expected results.

Guideline 1.1: Text Alternatives is an active part of W3C that is well-explained and developed. However, people continue to find its implementation difficult, unlike other guidelines (e.g. 2.4.9 Link Purpose (Link Only), 1.3.1 Info and Relationships, 2.4.6 Headings and Labels, 1.4.5 Images of Text, 1.4.4 Resize text, 1.4.1 Use of Color), which were found to be easily understood and applied in an exploration of techniques. The study 'An accessibility analysis of the top 1,000,000 home pages' analysed the home pages of the top 730 reliable domain levels, such as .com, .net and .edu, using the WAVE Stand-alone API (application programming interface). The finding showed that:

> There were 36,713,043 images in the sample, or 36.7 images per home page on average. 33.6% of all images (12.3 per page on average) had missing alternative text (not counting alt = “”). 18.5% of all images (6.7 per page on average) were linked images with missing or empty alternative text, resulting in both an alternative text issue and a link lacking any description. 16% of pages had images and no alt attributes at all. (WebAIM, 2019c, para. 14)

Recording tools was another element in this research. In Phase 1, TechSmith recorder software was selected to capture participant screens when completing assigned tasks in the awareness session. It was primarily selected to observe behaviours and to collect data that could not be collected from other research instruments (e.g. attitudes, time spent on tasks, use of accessible HTML elements, use of the system text editor and task completion). Obtaining data through visual recording has the advantage of revealing the types of activities participants are engaged in, ‘provides information on directionality and intensity of attention, which can be particularly useful in determining the levels of comfort and involvement of the interlocutors’ (DuFon, 2002, p. 44), and expands data in several ways. To use the recording tool, a recruitment and information letter (see Appendix D) was sent to participants to allow them to accept or reject their contribution to this study.

As part of this process, files, including a user manual and examples developed by the researcher, raw unstructured text to be inserted into the web pages (see Appendix A: Web page Content) and selected images were prepared for the participants. In conjunction with the final selection of tools, it was necessary to develop the tasks that needed to be completed by participants in the study. These tasks required participants to:

- add written content, including links and tables, to the web CMS
- logically structure written content
- insert images into the web CMS
- manipulate written content.

Once the design of instruments had been completed, the researcher tested them by coding and recording some answers using the Statistical Package for the Social Sciences (software for editing and analysing data) to ensure the reliability of questions, the validity of instruments and whether the data collected were within the predefined norms and aims. This work was done to prepare all the instruments for the pilot study.

3.2.2.2 Phase 2: Pilot study

This phase of the research aimed to test the research questionnaires, their delivery, participants' ability to implement the tasks in the selected web CMS tool and other elements of the study. Two weeks prior to the testing date, participants from the School of Science were invited by email by the lecturer of the unit to voluntarily participate in the pilot study. Six participants expressed a desire to participate in this phase. An informal follow-up letter was sent to interested participants outlining the date, time, place, researcher contact details and a brief explanation of the aims of the research (see Appendix D).

After completing the pre-test questionnaire, the six participants were randomly assigned to either the AAG or the AUG, with three in each group. The session followed the same process as that of the overall research design, shown in Figure 3.3 of this chapter. The aims of the session were to:

- test the instruments (flow, structure, content, question type)
- check strategies adopted
- estimate time allocated to the activities
- identify potential problems in the presentation, supportive documents and study environment.

Connelly (2008) states that:

> A pilot study has numerous purposes, such as developing and testing the adequacy of research instruments, assessing the feasibility of a full study, designing and testing the protocols for the larger study, establishing and testing the sampling and recruitment strategies, collecting preliminary data, obtaining effect size information, and training research assistants. In addition, pilot study results can convince funding agencies that the team can conduct the research and the larger study in fact is worthwhile. (p. 1)

The primary outcomes of this session were:

- Participants with some HTML knowledge (two in the AAG) incorporated some accessible HTML elements and completed the assigned tasks, while the other participants could not complete the assigned tasks.

- Participants' research strategies were limited. Apart from using Google as the main search engine, most participants, especially those in the AUG, conducted no further research.
- Two participants in the AUG simply copied and pasted content without using any enhancements.
- No participants in the AUG used the WordPress text editor to incorporate HTML codes.
- Participants in both groups spent more time on the home page, especially on the footer widgets (Join Us, Contact Us and Learn More), which took about 30 minutes for most participants to accomplish.
- Participants, mostly from the AUG, gave up quickly when encountering difficulties.
- Participants took some initiatives (such as disabling the recording when they faced difficulties) that may affect results.

The pilot study allowed for the detection of any significant instrumental, behavioural and managerial problems so that appropriate solutions could be established and tools and documents could be prepared ahead of the main study.

3.2.2.3 Phase 3: Main study

Any problems identified with instruments or their delivery were corrected before the start of this phase. Changes made were related to the following:

- Content: The length of the original content was unsuitable because it took more time for the participants to copy each section into the allocated pages. The content was reduced to keep it smooth and concise.
- Time: In the pilot study, four hours was assigned for the awareness session. Because this length of time was thought to result in hesitation from potential participants to contribute to the main study, three hours were allocated to the entire session (as shown in Figure 3.32). Figure 3.32 also shows the flow of tasks from the start to the end of the session.
- Recruitment: The original intention was to recruit participants from all four of Perth's universities. However, flyers displayed on university noticeboards for two

weeks failed to attract any interest. Therefore, the final decision was to include participants from Edith Cowan University (ECU) only.

- Recruitment strategy: Given that the flyer strategy was a failure, the researcher directly contacted students to ask for their voluntary participation.
- Conduct: To avoid data loss, particularly for recordings, participants were advised to not take any initiatives without notifying the researcher.
- Data type: Some questions types in the questionnaires were unsuitable for collecting the desired data. This problem was solved by changing the question type for some questions.
- Flow of questions: Some questions in the questionnaires were not in a suitable location and were moved to another topic section.
- Support: Some material in the documents provided to support the participants in their tasks contained unnecessary information, which was replaced or deleted to enable the collection of accurate and useful data.

Following rectification of the detected problems, the procedure carried out in the pilot study was repeated in the main study. Participant recruitment followed the same strategy as that in the pilot study, focusing on individuals who had experience using the web but did not self-identify as experts in web systems and technologies.

As mentioned previously, recruitment was done via direct contact. A target number of approximately 50 participants was sought, with that number to be divided randomly into the treatment and control groups (i.e. receiving training on accessibility awareness and receiving no training, respectively). However, it was difficult to recruit the target number and only 30 participants agreed to participate.

The researcher randomly selected students from both ECU campuses for participation in the study. Following their consent, students were contacted by email with information about and an invitation to the awareness session. The session was managed efficiently to allow collection of data for different operations and analysis.

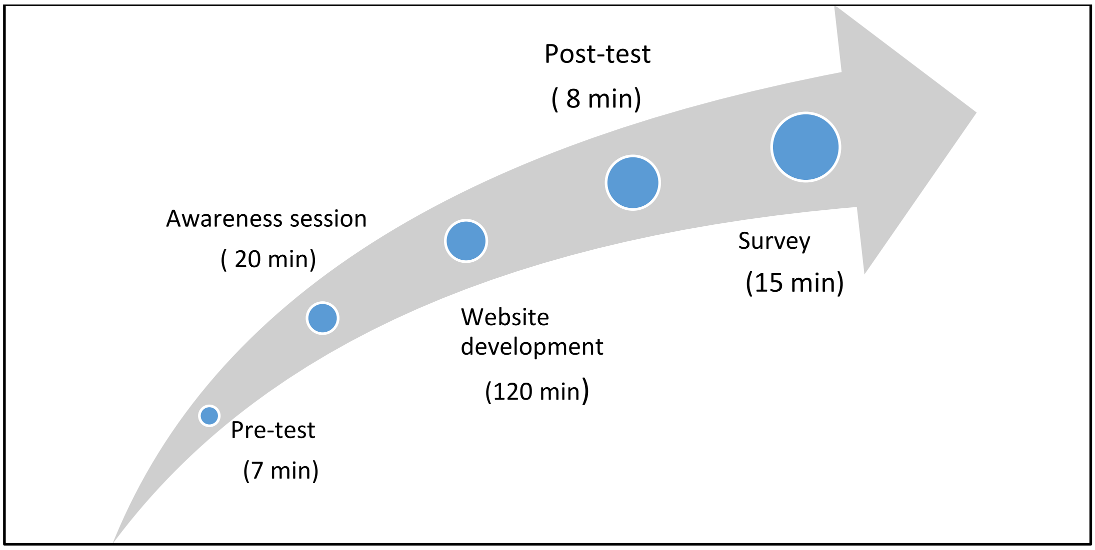


Figure 3.32: Workflow progress of the awareness session

3.3 Sampling

Sampling was done for both participants and the web CMS selected for developing the websites. The approach used for both sampling relied on combined methods, which were adequate for the selection of the final samples.

3.3.1 Participant Sampling

For selection of participants, multistage sampling combining three sampling methods was used. The first sampling method used to select the participants of the study was convenience sampling. This approach was based on selecting easily accessible participants from the Mt Lawley and Joondalup campuses of ECU. Further, the selection of university students was based on the fact that this cohort would soon be entering the workforce and potentially have the opportunity to use CMSs to create websites or manipulate site content. Students were also in a learning environment in which the use of high-tech sites was prevalent.

Etikan, Musa and Alkassim (2016) state that:

> Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of nonprobability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical

> proximity, availability at a given time, or the willingness to participate are included for the purpose of the study. (p. 2)

For participant recruitment, four specific schools were targeted with approximately one to three participants expected from each school to be allocated to each group (AAG or AUG). Once participants were recruited, stratified sampling was used to divide the students into two groups ('know basic HTML' and 'do not know basic HTML'). The need to identify the population by this characteristic makes this sampling approach viable for this step:

> Stratified random sampling (usually referred to simply as *stratified sampling*) is a type of probability sampling that allows researchers to improve precision (reduce error) relative to simple random sampling (SRS). The population is divided into non-overlapping groups, or *strata*, along a relevant dimension such as gender, ethnicity, political affiliation, and so on. The researcher then collects a random sample of population members from within each stratum. This technique ensures that observations from all relevant strata are included in the sample. (Salkind, 2010, p. 2)

Once the participants for each group ('know basic HTML' and 'do not know HTML') had been established, they were then grouped using simple random sampling into one of two groups—AAG or AUG, neither group were informed about each other's structure or activities as there was no attempt to prevent the AUG from finding information about accessibility, the research was actually more interested in whether they would even try. Simple random sampling ensured that all participants—whether or not they knew basic HTML—had an equal chance of being selected for the training group (AAG) or the non-training group (AUG).

> A simple random sample (SRS) is the most basic probabilistic option used for creating a sample from a population. Each SRS is made of individuals drawn from a larger population (represented by the variable N), completely at random. As a result, said individuals have an equal chance of being selected throughout the sampling process. The benefit of SRS is that as a result, the investigator is guaranteed to choose a sample which is representative of the population, which ensures statistically valid conclusions. (Better Evaluation, 2014, para. 1)

3.3.2 System Sampling

In this study, a mixed sampling procedure was used to select an appropriate system for website development and task completion. Selection of the system necessitated non-probability sampling because not all systems had a non-zero chance of being selected. Instead, established criteria were used to purposively select 30 systems for the initial list. These criteria included the following:

- Most highly ranked CMSs at the time of selection (2016)
- CMS trends in 2016
- Market shares in 2016
- Type of system: open-source CMSs.

The 30 systems selected were subjected to systematic random sampling up to the tenth system based on random scoring. The objective of this approach was to narrow the sample to a manageable level without losing randomness in selection. The ten systems were analysed for the following:

- Accessibility features supported by the web CMS: These included headings, colour, text resizing, lists, table creation, image (with alt text) insertion, video insertion, video captions and links. Systems were analysed for features that participants were required to find and implement during the awareness session. Scores of (0) and (1) were applied, respectively, for the absence or existence of these features in each system.
- The number of WCAG 2.0 issues (Level A and Level AA) generated from automated checking using SortSite 5: Sites were tested twice by the researcher to identify the number of issues and barriers in the developed websites. Assigned scores were based on the average number of issues for all pages and levels (Level A and Level AA).
- Manual checking by the researcher: This consisted of recording the sequential reading using the NonVisual Desktop Access screen-reader tool, which allows interaction with the computer when both screen and screen readers are on.

Although there was no intention to use automated or manual checking of participant tasks (which were done for the purpose of accessibility practice and awareness), web CMSs were assessed for the ‘noise’ they created in terms of the overall environment versus the content created by the participants. Once checking was complete, the scores were aggregated and the system with the highest score—WordPress—was selected for the study.

3.4 Statistical Methods and Tests

This research used statistical methods and tests to allow a comparison of the two groups, AAG and AUG. Results of some statistical tests performed on the data were significant, showing improvement in both groups following the awareness session and implying a probable relationship between variables. The following provides a brief description of the methods and tests used in the current study.

3.4.1 Statistical Methods

Three statistical methods were selected for this research to analyse selected data in various ways. The first method used was the ranking method, which enables participants to rank responses in order of preference or importance (Henderson, 2015). Answers may then be aggregated by their item numbers and used to define the order of items depending on their popularity. Henderson (2015) explains the procedure as follows:

- First, a weight is assigned to each ranking position, with weights being applied in reverse. For example, if a question has three possible answers, the first answer would be assigned a weight of 3, the second answer would be assigned a weight of 2, and the third answer would be assigned a weight of 1.
- Second, the average for each answer is calculated by aggregating the product of all weighting positions and the number of participants who selected Answer 1, Answer 2, and so on. Then, this is divided by the total number of participants who responded to the question. (p 1)

This method was applied to the survey question Q3.6 (see Appendix A: Survey Questionnaire) for which participants had to rank, in descending order, the tasks they found difficult to implement. Ranking helped to identify the problematic tasks for the participants in this study (see Table 4.34) and the greatest difficulties encountered.

The second method used in this research was a usability measure that (Nielsen, 2001) terms the 'user success rate' or 'the percentage of tasks that users complete correctly'. In this method, three situations are considered: success, failure and partial success. The first two possibilities are straightforward, with 'success' indicating that the user completed the task (eliciting a score of 1) and 'failure' indicating that the user did not complete the task (eliciting a score of 0). (Nielsen, 2001) states that 'It's certainly a simple model: either users do everything correctly, or they fail. No middle ground. Success is success, without qualification' (p. 1). However, when users complete some tasks and fail in others, a score of 0 is not appropriate—in these cases, Nielsen allocates 0.5 points for each partial success. To calculate the success rate (%), he uses the following formula:

> Success rate (%) = (number of successful attempts + (number of partially successful attempts * 0.5))/total number of attempts.

In this study, this method was used for the completion of tasks (text, titles, images, table content, form and videos) and features (formatting, structure and layout). Similar to Nielsen's method, participants who completed all tasks were allocated a score of 1 and those who failed to complete all tasks were allocated a score of 0. Participants who completed some tasks but not others were allocated a score of 0.5. Based on the scores of most of the sites (50%), the resulting success scores for task completion was considered.

The final method used was the Likert scale, which measures people's attitudes and opinions about products, performances or services. Likert scales are based on a number of points ranging from five to seven, allowing people to express agreement or disagreement with statements:

> Likert scales were developed in 1932 as the familiar five-point bipolar response that most people are familiar with today. These scales range from a group of categories-least to most-asking people to indicate how much they agree or disagree, approve or disapprove, or believe to be true or false. There's really no wrong way to build a Likert scale. The most important consideration is to include at least five response categories. (Allen & Seaman, 2007, p. 1)

In this study, the Likert method was used so that participants had the opportunity to express their opinions about various aspects (e.g. tools, time and environment) of the awareness session. Participants provided feedback to help identify the strengths and weaknesses of the awareness session.

3.4.2 Statistical Tests

The current study used three statistical tests: *t*-test, Spearman's rho correlation and paired *t*-test.

3.4.2.1 The independent sample t-test

The *t*-test, also called student's *t*, is a parametric test used to compare the means of two independent groups and identify whether there is a significant difference between the two means. The test assumes that:

- data are independently and randomly sampled
- the dependent variable is on a continuous scale and the independent variable is on an ordinal scale
- data are normally distributed
- there is equality of variance (assumption of homogeneity), a hypothesis testing the variance equality of two groups.

This research used *t*-tests (see Section 4.3.2) to investigate differences in outcomes for the AAG and AUG when applying tasks and accessibility components.

3.4.2.2 Spearman's rho correlation

Spearman's rank correlation coefficient (r_s) is a non-parametric test used when assumptions of correlation are not met. It measures the strength of the relationship between continuous or ordinal variables. The coefficient can assume values from −1 to +1, with the signs + and − indicating positive or negative correlations. The value of *r* (without the sign) provides an indication of the strength of the relationship. According to Cohen (2013), the interpretation of the values between 0 and 1 are:

- r = .10 to .29 → there is a small correlation between the two variables
- r = .30 to .49 → there is a medium correlation between the two variables
- r = .50 to 1.0 → there is a large correlation between the two variables. (p. 456)

A correlation of 0 indicates no relationship between the two variables, while a correlation of 1 or −1 indicates a perfect positive or negative correlation, respectively.

In this research, Spearman's coefficient was used as an alternative to Pearson correlation coefficients to measure the strength of the relationship between task completion and HTML and accessibility knowledge.

3.4.2.3 Paired t-test

The paired *t*-test was the third method used in this study. The paired *t*-test (also referred as the dependent sample *t*-test) is 'a statistical procedure used to determine whether the mean difference between two sets of observations is zero. In a paired sample *t*-test, each subject or entity is measured twice, resulting in pairs of observations' (Statistics Solutions, 2019).

According to Laerd Statistics (2018), four assumptions strengthen the paired *t*-test:

- Assumption 1: The dependent variable should be continuous.
- Assumption 2: The independent variable should consist of two related groups, meaning that the same subjects should be in both groups (the same subject is measured at different times on the same dependent variable).
- Assumption 3: There are no significant outliers (unusual patterns in the data) between the two related groups.
- Assumption 4: There is an approximate normal distribution of the difference in the dependent variable between the two related groups. (para. 3)

The paired *t*-test (calculated in Tables 4.36 and 4.37) was used to test if there was a difference in means between the pre- and post-tests in the AAG's HTML and accessibility knowledge to analyse the effectiveness of the awareness session training.

3.5 Validity and Reliability

In this research, the concepts of validity and reliability were considered to measure the accuracy of tools and the consistency of items. Given the qualitative and quantitative methods adopted and the instruments used to collect data, it was imperative to confirm that all questionnaires for testing (pre- and post-tests and surveys) aligned with the aims of the study and that their application ensured the consistency of data obtained from these instruments (the testing process was outlined in detail in Section 3.2.2).

According to Joppe (cited in Golafshani, 2003), validity in quantitative research:

> determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull's eye" of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others. (p. 599)

The questionnaires used in the current study were subject to the validation process, with content validity being a major focus. Content validity is 'the extent to which the questions on the instrument and the scores from these questions represent all possible questions that could be asked about the content or skill' (Mohajan, 2017, p. 15). Because this type of validity relies on the experts' decision, the questionnaires were reviewed by two statisticians who assessed the structure, logic and construct validity of the questions to ascertain the accuracy of the instruments.

Accordingly, ineffective and redundant questions or types of question (closed, open-ended or partially open-ended) or questions used to scale participants' attitudes such as the Likert scale were amended with assistance. In the first version of the questionnaires, the researcher used a seven-point rating scale; however, the statisticians recommended a five-point scale ranging from 'strongly agree' to 'strongly disagree' to provide better quality data and increase responses because participants may become frustrated with a larger rating scale, which may 'yield data to lower quality' (Revilla, Saris, & Krosnick, 2013).

The reliability of research instruments was checked in terms of consistency and accuracy of questions. Internal consistency of questions was tested to ascertain that closed questions incorporated a sufficient number of responses to capture information and other types of questions (open-ended and partially open-ended) included sufficient details to be of benefit and ensure a greater level of reliability.

Once the questionnaires were validated, the researcher tested whether the questionnaires would provide the intended results regarding accessibility and its concepts, and whether the Likert scale would efficiently measure participants' attitudes towards the awareness session and the awareness training session. Testing also considered the clarity, practicality and sufficiency of questions in all the questionnaires used in this research.

3.6 Ethical Considerations

In most research projects involving humans, it is imperative to consider ethical issues and safety (Byrne, 2016). According to WHO (2019), 'Research ethics govern the standards of conduct for scientific researchers. It is important to adhere to ethical principles in order to protect the dignity, rights and welfare of research participants'. (para. 1)

This study involved participants in the web-based survey and pre- and post-tests. Consideration of ethics was necessary to protect and alleviate any concerns of participants regarding their participation and personal information. Approval from the university's Human Research Ethics Committee (see Appendix D) was the first step to consider prior to the data collection phase. All participants that voluntarily agreed to join the awareness session were provided with a consent form, which they were asked to read and sign if they were still willing to participate, prior to the commencement of the awareness session.

In the consent form, participants were informed about the awareness session environment and the process of the session, including screen recording. They were also assured that they could withdraw at any time without explanation or penalty, that their information would remain confidential, that no personal identification would be disclosed and that data would be used for research purposes only. As stated by the Nuremburg Code, which provides ethical guidelines for experimentation with humans (Office of Behavioral and Social Sciences Research, 2019), as long as a study respects the privacy and rights of participants, the use of humans in research is allowable. The code stipulates that the use of human participants is justified as long as:

- human subjects are necessary
- the results hold promise of benefit to society
- scientific basis and design are sound
- harm to humans is minimised or avoided
- risks are minimised
- experimenters are qualified
- voluntary withdrawal of subjects is allowed

- the research is terminated if research subjects are likely to be injured or harmed. (para. 1)

3.7 Chapter Summary

This chapter discussed the mixed methods approach adopted in this research and outlined the various methods and tools used to collect qualitative and quantitative data to ensure data convergence and triangulation.

A description of the different phases, from preparation to the testing phase to main study, was outlined. The three instruments used in the pre- and post-tests were explained. The different sections and content were delineated and typical examples were provided for clarification. The chapter also focused on the sampling methods used to select the participants for the study and WordPress as an appropriate system to complete the tasks required.

The validity of questionnaire content was a concern in this research. Two experts checked the instruments to validate the structure, logic and extensiveness of these tools to allow the collection of beneficial information for the study. Further, internal reliability was checked for uniformity and precision of questions. Ethics were also considered in this study because of social participation of humans, for whom protection is an immediate concern. All these measures were necessary to provide data, the results of which are discussed in the following chapter.

CHAPTER 4: RESEARCH RESULTS

This chapter presents the data derived from the recordings, pre- and post-tests and the survey, along with the methods and tests explained in Chapter 3. The current research used two groups—AAG and AUG—to compare participants' performances in undertaking a series of accessibility tasks. The first section of this chapter provides participant demographics, while the second section presents information on internet use and existing accessibility knowledge. The third section examines how the participants performed, completed and succeeded in the required tasks, with an emphasis on their pre- and post-understanding and contributions. The fourth section highlights participants' behaviours and improvement in skills acquired after the awareness session, while the fifth section focuses on suggestions and feedback about the research and its components (environment, system used and abilities acquired). The final section provides a summary of the research results based on the presented data. A full discussion and exploration of the implications of these results is provided in Chapter 5.

4.1 Demographic Data

Demographic data were collected from research participants via a web-based survey, providing an overview of gender and age characteristics of the participants in this study.

4.1.1 Overall Demographics

4.1.1.1 Demographics by gender

Examination of the distribution of gender (shown in Figure 4.1) and the value of skewness (1.884) indicate that the data were positively skewed towards male participants. Additionally, the distribution had a lower kurtosis value (1.884), showing that the distribution was significantly non-normal regarding kurtosis (which provides the peakedness of the distribution) (Joanes & Gill, 1998).

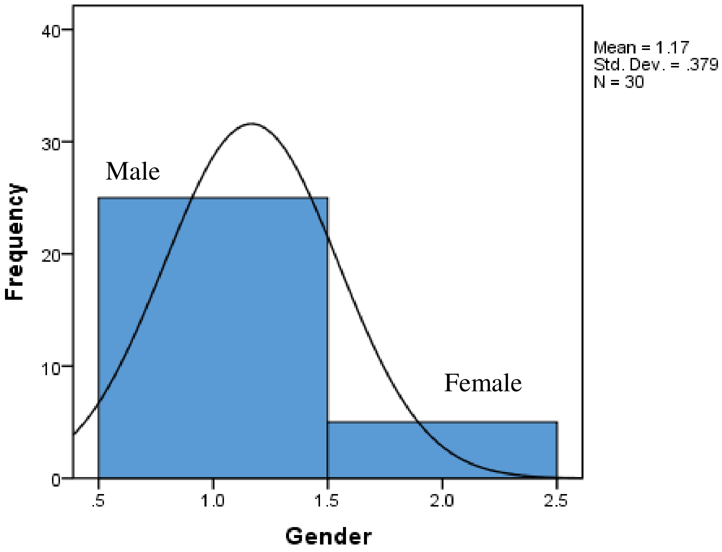


Figure 4.1: Distribution by gender

The distribution of the participants (shown in Figure 4.2) shows that the majority of the participants in this research were male (83.3%), while female participants represented only a minor proportion (16.7%), which explains the high level of data skewness observed in Figure 4.1. The skewed distribution of male to female participation in this research may be a result of the population from which the sample was drawn (i.e. although it was cross-disciplinary in nature, most of the interest in participation was from males).

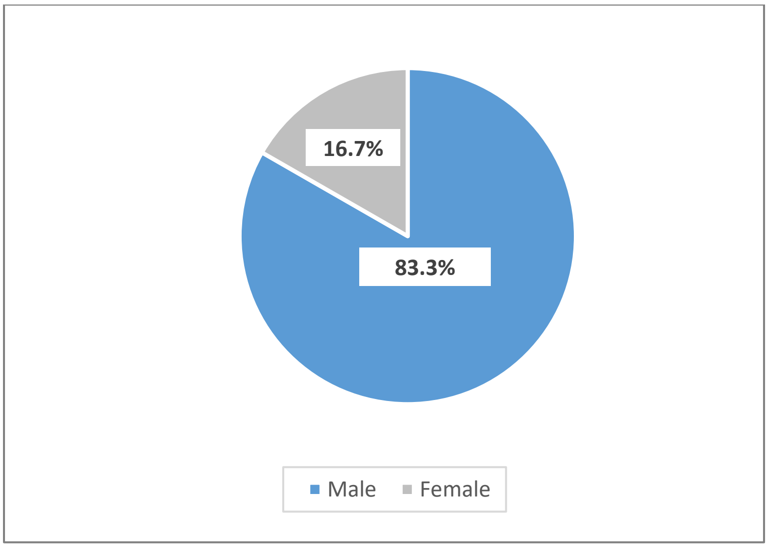


Figure 4.2: Proportion of participants by gender

4.1.1.2 Demographics by age

Figure 4.3 provides an overview of the distribution of age according to six age groups (also shown in Figure 4.4). Given that the mean (2.6) was higher than the median (2.0), the data were positively skewed towards participants in the age range of 20–23. The value of skewness did not fall in either the positive or negative range of the doubled standard error of kurtosis (2*0.833); therefore, the distribution was significantly non-normal (see Figure 4.3).

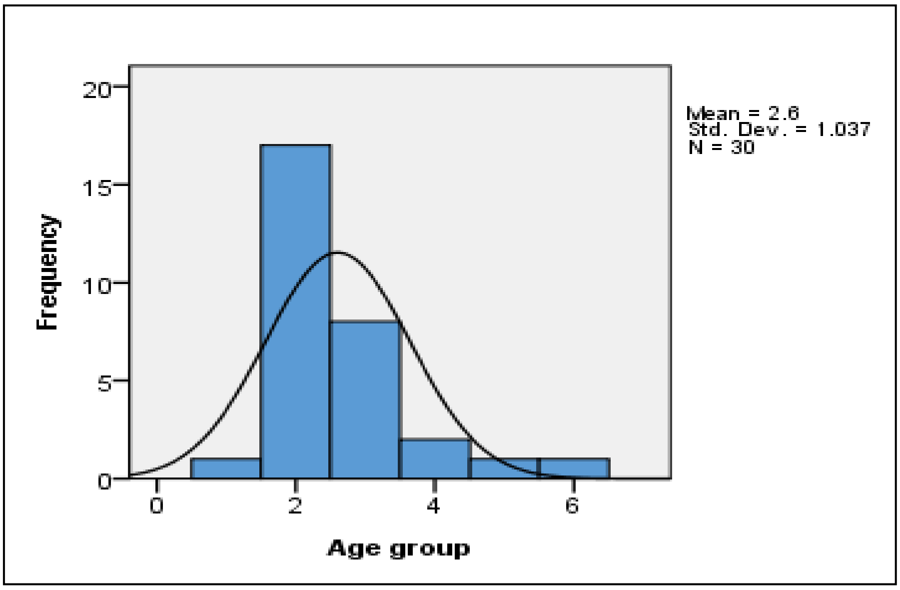


Figure 4.3: Distribution of participants by age group

The breakdown of participants by age range is presented in Figure 4.4, indicating that most of the participants ranged from 20 to 30 years of age (56.7%), followed by 30–40 (26.7%) and 40–50 (6.7%). Other age ranges made up the remaining 10%.

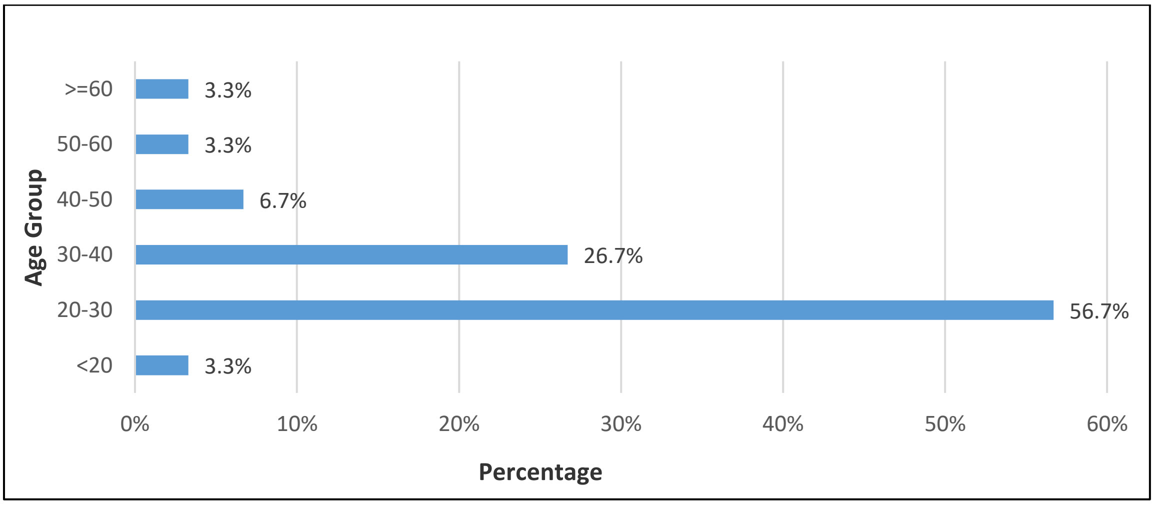


Figure 4.4: Distribution of participants by age

4.1.2 Demographics by Group

Figure 4.5 represents a normal curve. The mean and median are equal (1.50) and the skewness is null, which signifies that the data have a perfect symmetrical distribution (15 participants in each group).

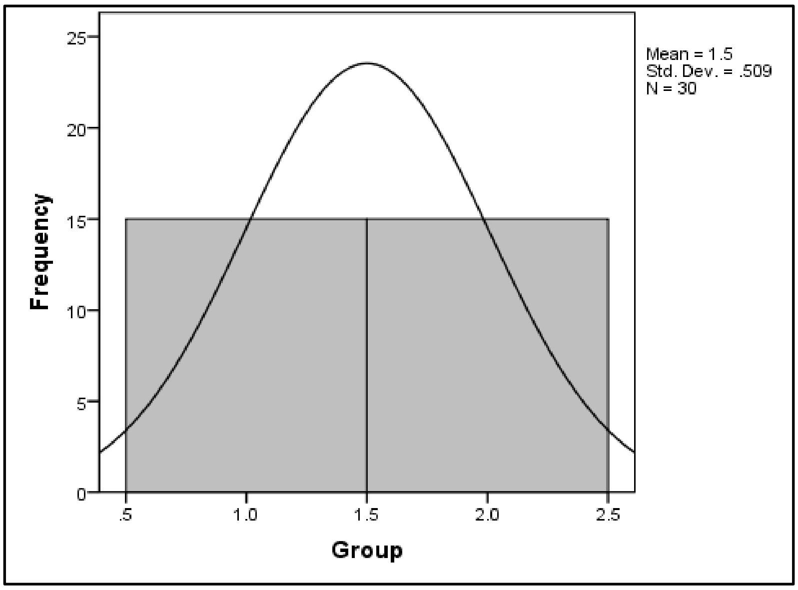


Figure 4.5: Distribution of participants by group

4.1.2.1 Demographics by gender and group

Table 4.1 provides an overview of the distribution of participants by group and gender. The number of male and female participants in each group (n = 15) was similar (13 and 12 males in the AAG and AUG, respectively, and two and three females in the AAG and AUG, respectively). A higher percentage of male participants were allocated to the AAG (86.7%), while a higher percentage of the female participants were allocated to the AUG (20%). A similar tendency was noted in the percentages of the total (N = 30) for both genders, with males representing 43.3% of the total for the AAG and 10.0% of the total for the AUG. These results suggest similar outcomes from previous figures.

Table 4.1: Participants by gender and group

Gender		Group		Total
		AAG	AUG	
Male	Frequency	13	12	25
	% of group	86.7%	80.0%	83.3%
	% of total	43.3%	40.0%	83.3%
Female	Frequency	2	3	5
	% of group	13.3%	20.0%	16.7%
	% of total	6.7%	10.0%	16.7%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

4.1.2.2 Demographics by age and group

Table 4.2 shows that most participants in the AAG were aged 20–30 years or 30–40 years (46.7%), with an equal number of participants falling into these age ranges (7 participants of 15). In the AUG group, 10 of the 15 participants (66.7%) were in the same age group. Records show that in the AAG, there were no participants under 20 years of age or between 40 and 60 years of age, and in the AUG, there were no participants over 60 years of age. Data also show that more than half of the participants (17) in both groups were in the 20–30-year age group (56.7%), followed by the 30–40-year age group (26.7%) and then the 40–50-year age group (6.7%). Other age groups comprised only 3.3% of the total. As seen in previous results, the 20–30-year age group was predominant.

Table 4.2: Participants by age and group

Group		Age group						Total
		< 20	20–30	30–40	40–50	50–60	> = 60	
AAG	Frequency	0	7	7	0	0	1	15
	% of group	0.0%	46.7%	46.7%	0.0%	0.0%	6.7%	100%
	% of total	0.0%	23.3%	23.3%	0.0%	0.0%	3.3%	50.0%
AUG	Frequency	1	10	1	2	1	0	15
	% of group	6.7%	66.7%	6.7%	13.3%	6.7%	0.0%	100%
	% of total	3.3%	33.3%	3.3%	6.7%	3.3%	0.0%	50.0%
Total	Frequency	1	17	8	2	1	1	30
	% of group	3.3%	56.7%	26.7%	6.7%	3.3%	3.3%	100%
	% of total	3.3%	56.7%	26.7%	6.7%	3.3%	3.3%	100%

4.1.3 Summary

Overall, results show that most of the participants in this research were male and aged 20–30 years, while the number of females was relatively small. The next section discusses the participants' knowledge and web usage.

4.2 Internet Use and Accessibility Knowledge

The previous section provided an overview of the demographics of the sample population in this study. This section presents the participants' self-reported experiences regarding internet use and HTML and accessibility knowledge. Data were gathered using two primary sets of instruments, a web-based survey and pre-test (as outlined in Chapter 3). Results used in the first section were derived from the survey and those for the second section were derived from the pre-test.

4.2.1 Internet Use and Experience

4.2.1.1 Internet use (in years)

As the data in Table 4.3 indicate, the majority of participants (86.7%) had been using the internet for at least six years. 100% of participants in the AAG and 73.3% of participants in the AUG had used the internet for six years or more. Given the almost universal presence of internet connectivity in modern society, it is perhaps surprising that any of the participants reported the use of the internet for a period of fewer than six years.

Table 4.3: Years of internet use per group

Years of internet use		Group AAG	Group AUG	Total
2–3 years	Frequency	0	1	1
	% of group	0.0%	6.7%	3.3%
	% of total	0.0%	3.3%	3.3%
4–5 years	Frequency	0	1	1
	% of group	0.0%	6.7%	3.3%
	% of total	0.0%	3.3%	3.3%
5–6 years	Frequency	0	2	2
	% of group	0.0%	13.3%	6.7%
	% of total	0.0%	6.70%	6.7%
> = 6 years	Frequency	15	11	26
	% of group	100%	73.3%	86.7%
	% of total	50.0%	36.7%	86.7%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

4.2.1.2 Internet use purpose

When asked about their purpose for using the internet, most participants reported using it for studying (93.3%), followed by socialising (70%) and playing games (40%). In the 'other' category (Figure 4.6), 63.3% of participants identified that they used the internet for communicating, while 36.7% used it for working. There was minimal disparity between the two participant groups in internet use—100% of the AAG and 86.7% of the AUG used the internet for studying (see Table 4.4).

Table 4.4: Purpose for internet use per group

Purpose of use[a]		**Group**		**Total**
		AAG	**AUG**	
Uses the internet to study	Frequency	15	13	28
	% of group	100%	86.7%	
	% of total	50.0%	43.3%	93.3%
Uses the internet to socialise	Frequency	9	12	21
	% of group	60.0%	80.0%	
	% of total	30.0%	40.0%	70.0%
Uses the internet to play games	Frequency	7	5	12
	% of group	46.7%	33.3%	
	% of total	23.3%	16.7%	40.0%
Other	Frequency	11	8	19
	% of group	73.3%	53.3%	
	% of total	36.7%	26.7%	63.3%
Total	Frequency	15	15	30
	% of total	50.0%	50.0%	100%

Note: Percentages and totals are based on respondents; [a] Dichotomy group tabulated at value 1.

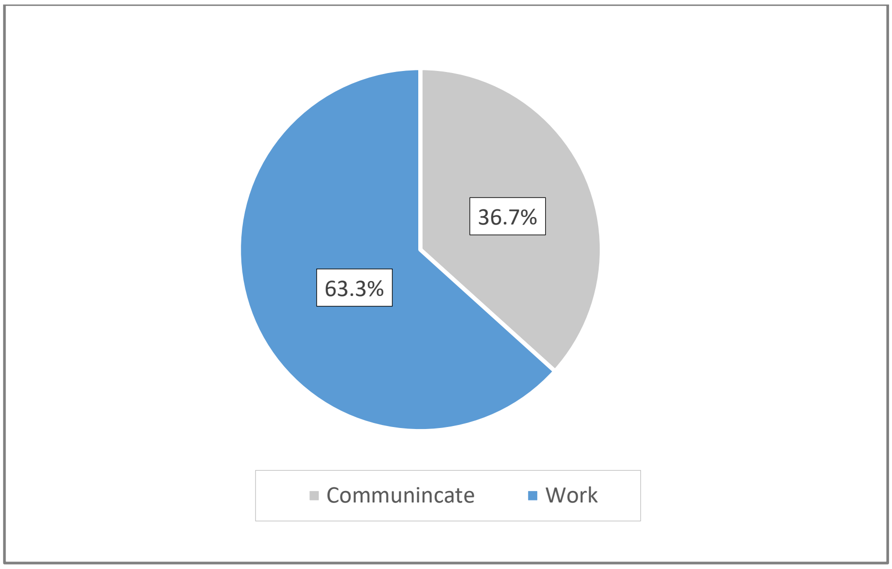


Figure 4.6: Other purposes for internet use (N = 30)

4.2.1.3 Internet experience

The participant's experience level in using the web, as identified from the survey, varied between medium (11 participants in total) to very low (one participant). Table 4.5 shows that in the AAG, nearly half the respondents (six) claimed a medium level and two had a low level of experience. In contrast, in the AUG, approximately half the participants reported that their level was good (seven participants) and one stated a very low level of experience in using the web. For the 10 participants who rated their level of experience as good, seven were from the AUG compared with three from the AAG. Of those rating their level as very good, 66.7% were from the AAG and 33.3% were from the AUG.

Table 4.5: Experience level in using the web per group

Web Experience Level		**Group**		**Total**
		AAG	AUG	
Very low	Frequency	0	1	1
	% of group	0.0%	6.7%	3.3%
	% of total	0.0%	3.3%	3.3%
Low	Frequency	2	0	2
	% of group	13.3%	0.0%	6.7%
	% of total	6.7%	0.0%	6.7%
Medium	Frequency	6	5	11
	% of group	40.0%	33.3%	36.7%
	% of total	20.0%	16.7%	36.7%
Good	Frequency	3	7	10
	% of group	20.0%	46.7%	33.3%
	% of total	10.0%	23.3%	33.3%
Very good	Frequency	4	2	6
	% of group	26.7%	13.3%	20.0%
	% of total	13.3%	6.7%	20.0%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

Results also show that all participants in the AAG, regardless of experience level, had been using the web for more than six years (Figure 4.7). Most of the participants in the AUG had the same number of years of usage (as shown in Table 4.3). Those with more than six years use had medium, good and very good levels of experience.

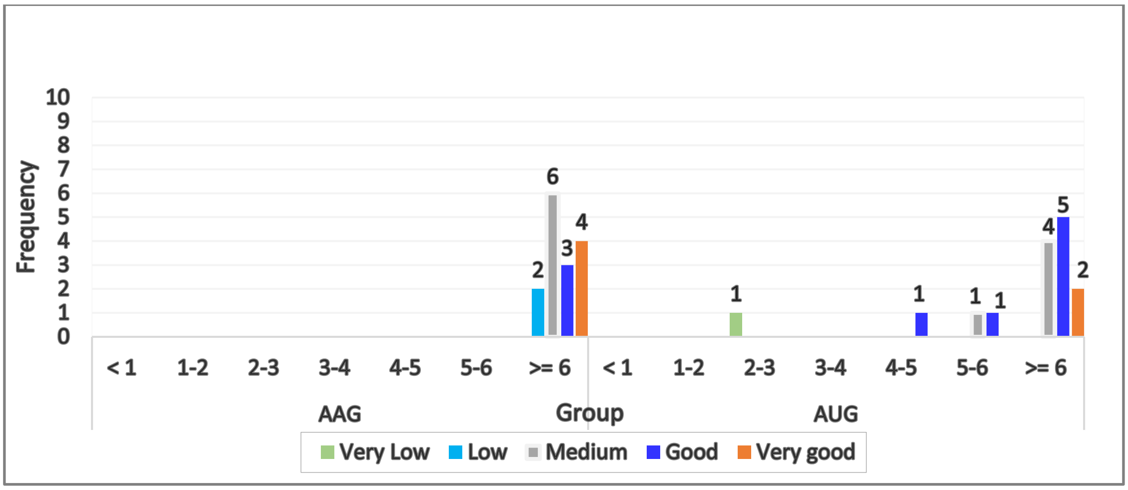


Figure 4.7: Self-evaluation of experience level and number of years using the internet

In summary, these results show that most of the participants in both groups had been using the web for a long period and their self-evaluated experience level ranged from medium (AAG) to good (AUG). Their experiences implies that they had acquired some abilities in dealing with the web and its components.

4.2.2 HTML Skills

Data from the pre-test showed elementary and fundamental HTML skills of all participants ($N = 30$), which was one of the emphases of this study.

4.2.2.1 Elementary HTML

The most remarkable aspect of Figure 4.8 is that a significant number of participants, 40.0% and 36.7% for AAG and AUG, respectively, did not know which HTML element does not need the end tag </>. It also shows that 6.7% of participants in the AUG and only 3.3% of participants in the AAG provided the correct answer.

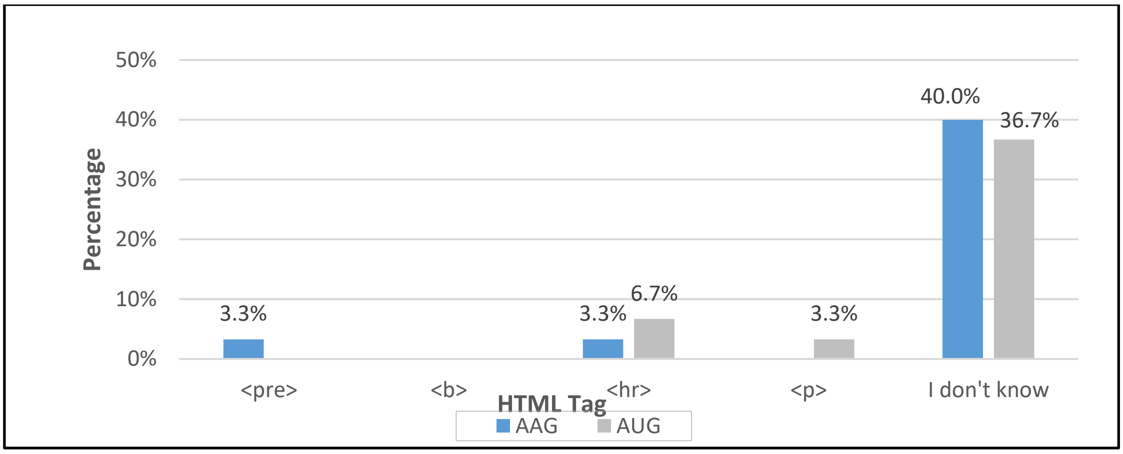


Figure 4.8: Group responses for the HTML element that does not need the end tag </>

When asked about the HTML element used in the first heading in a document (Figure 4.9), only 3.3% of the participants knew the correct answer and 23.3% did not know. The remainder gave incorrect answers for the heading's code.

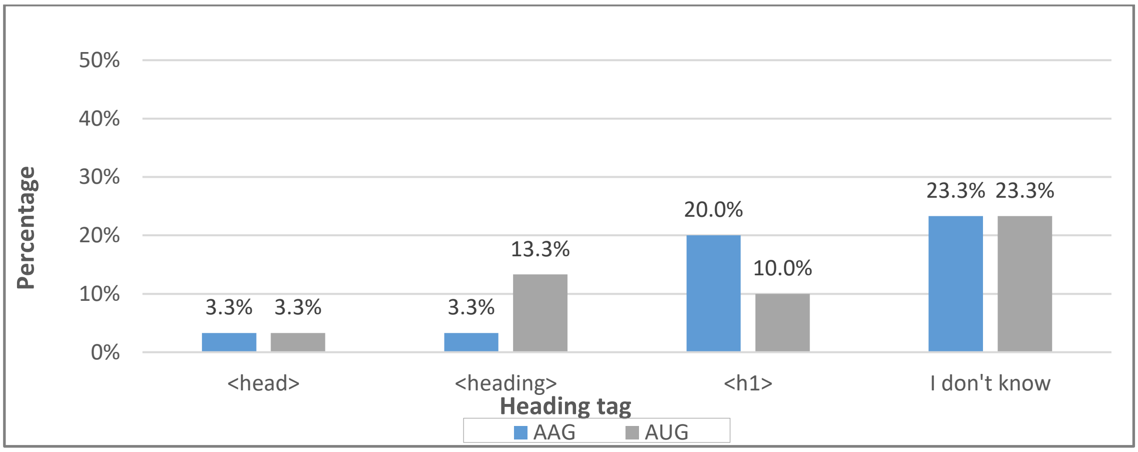


Figure 4.9: Participant responses on the HTML element used in the topmost heading in a document (prior to accessibility awareness session)

Approximately one-third of participants from both groups (36.7% for AAG and 33.3% for AUG) chose 'I do not know' when asked to select the correct code for an HTML comment. Three participants in AAG (10%) and two in AUG (6.7%) knew the correct answer, while the rest of the participants did not know (Figure 4.10).

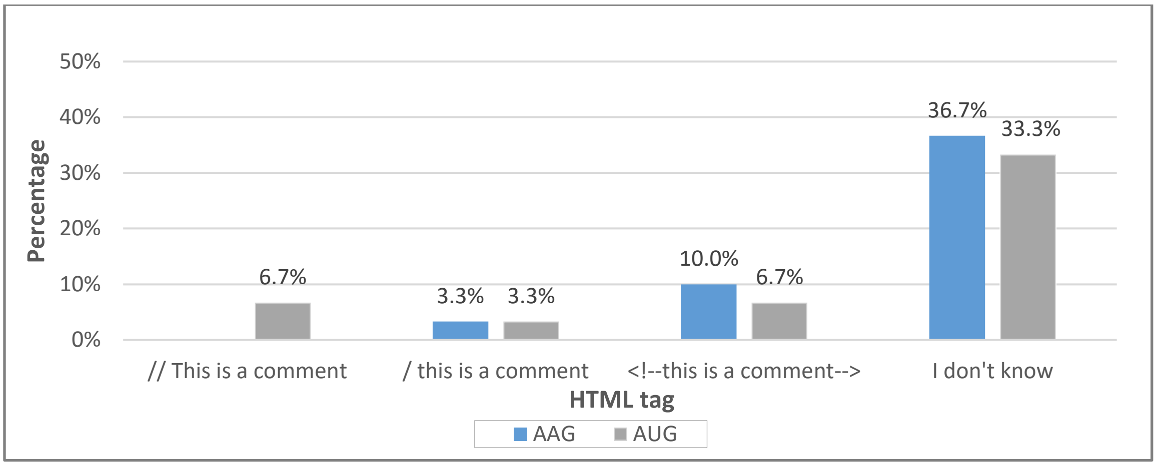


Figure 4.10: Participant response to the correct approach for a code comment in a document (prior to accessibility awareness session)

The most striking result to emerge from the data was that even when participants in both groups declared that they had a long history of using the internet (Figure 4.7) and evaluated themselves as having 'medium' or 'good' experience levels (Table 4.5), most of them did not have basic HTML skills and only a few provided the correct answer for the elementary HTML codes.

4.2.2.2 Fundamental HTML

Figure 4.11 shows that 36.7% of the participants in the AAG did not know HTML code for headings. Only 3.3% provided a correct answer while the remainder selected incorrect answers. In contrast, 20.0% of the participants in the AUG did not know the answer—16.7% selected the correct code while the remainder made an incorrect choice.

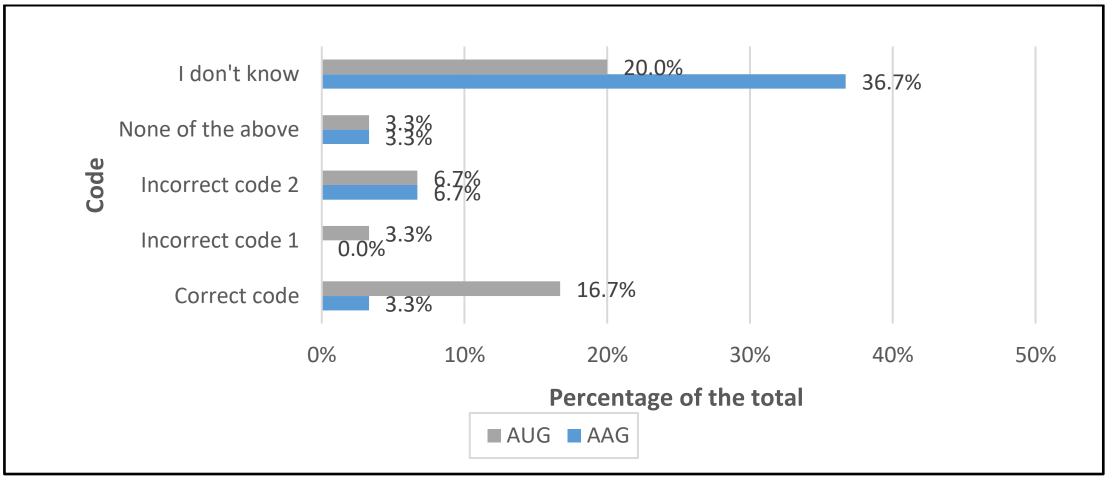


Figure 4.11: Participant response to the accessible HTML code for headings (prior to the accessibility awareness session)

Responses to the HTML accessible code for the use of images, as shown in Figure 4.12, indicates that, for both the AAG and AUG, three out of 10 participants did not know the correct code. In the AAG, four participants provided the correct answer (13.3%) and two selected the incorrect code. In contrast, five participants from the AUG provided the correct response (16.7%) and only one participant did not.

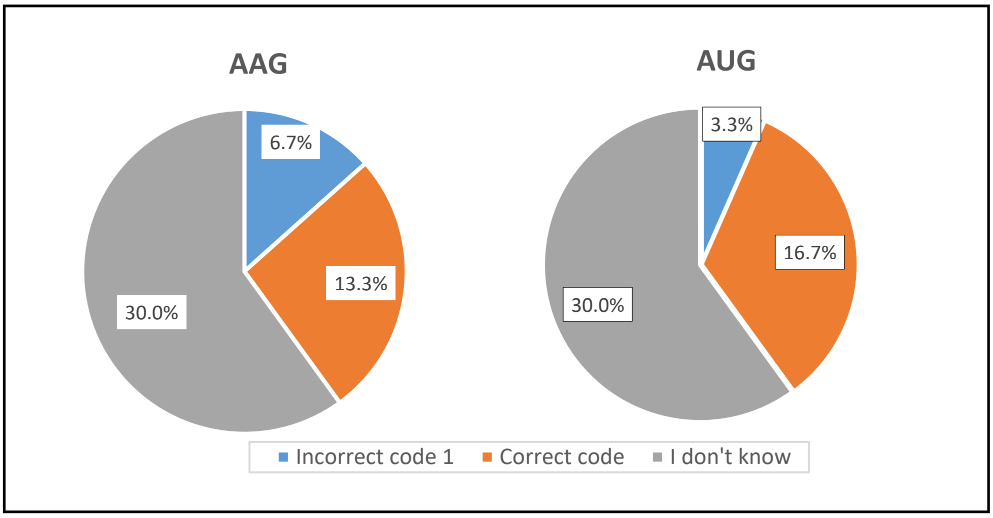


Figure 4.12: Participant response to the accessible HTML code for images (prior to the accessibility awareness session)

The majority of participants did not know the correct response to the question associated with HTML tables. 36.7% of AUG participants and 30.0% of AAG participants selected 'I don't know' (see Figure 4.13). Interestingly, only participants from the AUG provided the correct answer (10.0%), while none from the AAG did.

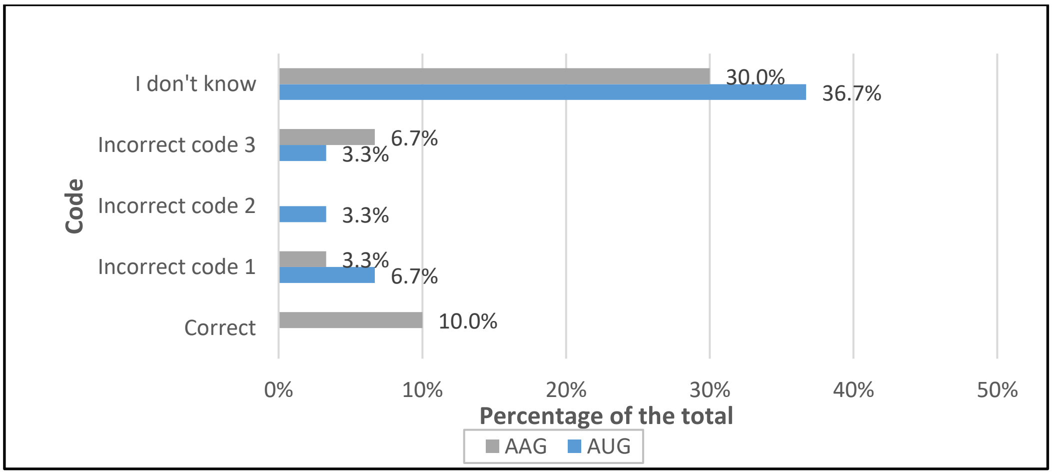


Figure 4.13: Participant response to the accessible HTML code to create a table with three columns (prior to the accessibility awareness session)

Unsurprisingly, when participants were asked to identify the correct code for accessible HTML tables, most of them could not identify the correct code (Figure 4.14). Only one participant (3.3%) from the AAG and two (6.7%) from the AUG provided the correct answer.

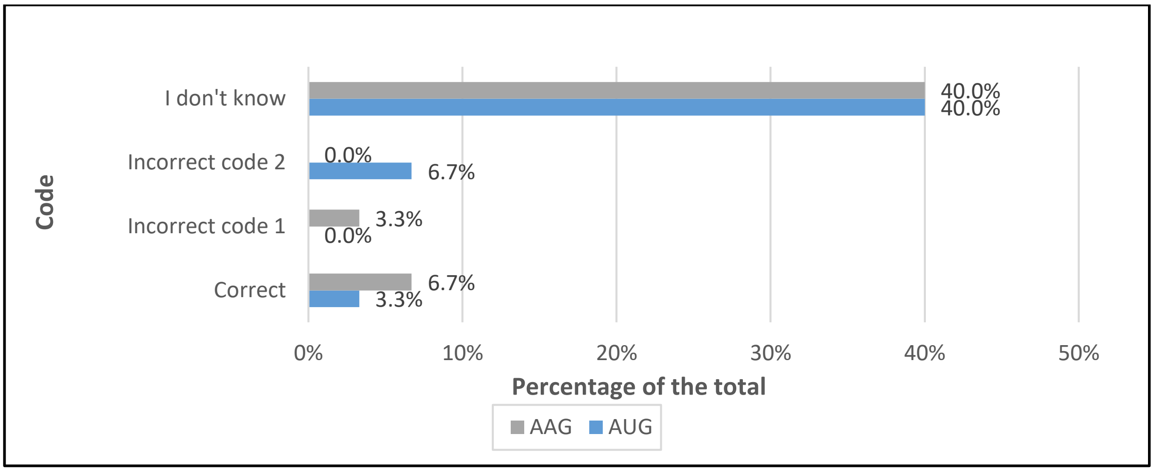


Figure 4.14: Participant response to the accessible HTML code for the table (prior to the accessibility awareness session)

When asked about the correct code for an accessible hyperlink, 30% of AAG participants and 23.3% of AUG participants responded that they did not know the correct code. Figure 4.15 also shows that 10.0% participants from the AUG answered correctly compared with only 3.3% from the AAG.

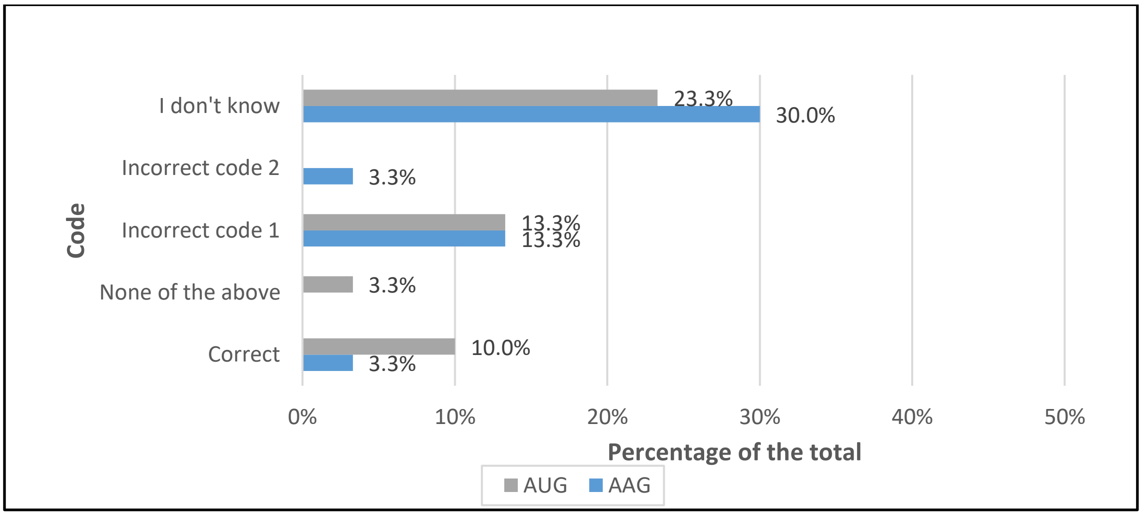


Figure 4.15: Participant response to the accessible HTML code for the hyperlink (prior to the accessibility awareness session)

Figure 4.16 shows that participants in the AAG (33.3%) and the AUG (26.7%) were not familiar with HTML hyperlink code. A limited and equal number answered correctly for both groups (10%).

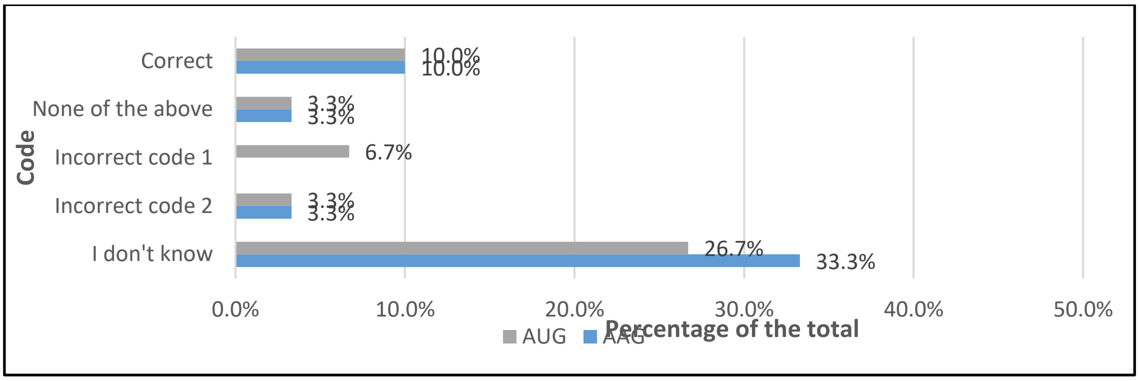


Figure 4.16: Participant response to the accessible HTML text colour (prior to the accessibility awareness session)

A significant number of participants also did not know how to embed a video into the web page using an accessible HTML element. As shown in Figure 4.17, 12 participants (40.0%) from AAG and 10 participants (33.0%) from AUG reported that they did not know. In both groups, only one participant responded correctly, while a minority provided incorrect answers.

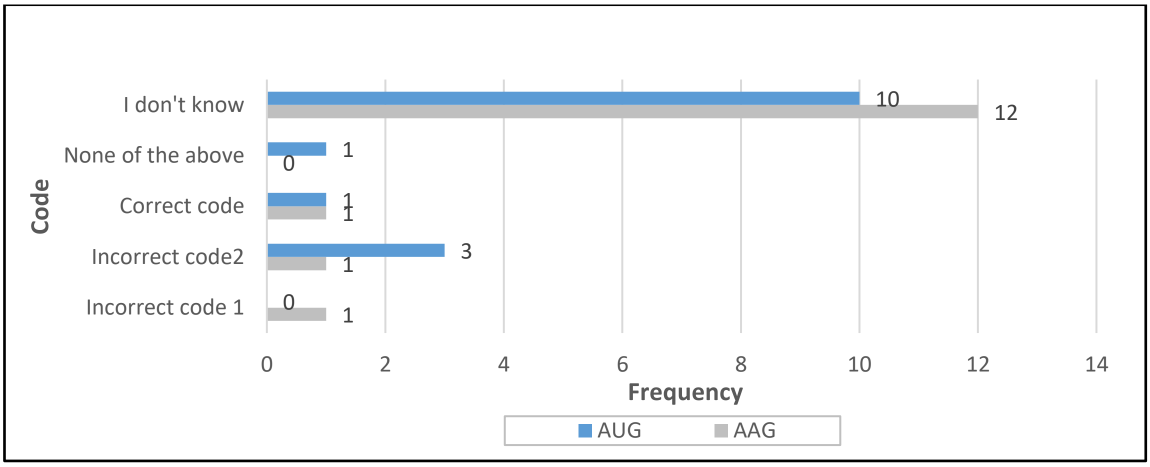


Figure 4.17: Participant response to the accessible HTML to embed video into web pages (prior to the accessibility awareness session)

Pre-test results indicate that the participants in this study did not have fundamental HTML skills. With respect to HTML basics, both groups showed low skills in HTML coding. However, it appeared that participants in the AUG were more likely to be knowledgeable than those in the AAG. The next section discusses participant understanding of accessibility.

4.2.3 Concept of Accessibility

Results from the survey (see Table 4.6) provided information related to participants' understanding of web accessibility prior to the accessibility awareness session. In the AAG, more than half (53.3%) the participants (26.7% of the total participants in the study) had poor knowledge of accessibility and none had a good understanding. Conversely, 40% of participants in the AUG (n = 15) and of the total number of participants (n = 30) stated that they had a 'fair' notion, while five had never heard of it. Four participants stated having a good understanding of accessibility.

Table 4.6: Pre-existing web accessibility knowledge

Web accessibility understanding		Group		Total
		AAG	AUG	
Never heard of it	Frequency	2	3	5
	% of group	13.3%	20.0%	16.7%
	% of total	6.7%	10.0%	16.7%
Poor	Frequency	8	1	9
	% of group	53.3%	6.7%	30.0%
	% of total	26.7%	3.3%	30.0%
Fair	Frequency	5	7	12
	% of group	33.3%	46.7%	40.0%
	% of total	16.7%	23.3%	40.0%
Good	Frequency	0	4	4
	% of group	0.0%	26.7%	13.3%
	% of total	0.0%	13.3%	13.3%
Total	Frequency	15	15	30
	% of group	100.0%	100.0%	100.0%
	% of total	50.0%	50.0%	100.0%

When asked to evaluate their understanding of web accessibility, half of the 30 participants selected 'good'. Only two participants chose 'excellent'. Additionally, only one participant in the AAG and no participants from AUG provided an answer.

From before the awareness session (Table 4.6) to participating in the awareness session (Table 4.7), it appears that participants became more familiar with the notion of web accessibility. Prior to the awareness session, zero and four participants in AAG and AUG, respectively, rated themselves as having a 'good' understanding of web accessibility. Following the session, this number increased to seven for AAG and eight for AUG.

Table 4.7: Self-evaluated understanding of web accessibility when participating in the accessibility awareness session

Web Accessibility Understanding		**Group**		**Total**
		AAG	**AUG**	
Cannot say	Frequency	1	0	1
	% of group	6.7%	0.0%	3.3%
	% of total	3.3%	0.0%	3.3%
Poor	Frequency	3	1	4
	% of group	20.0%	6.7%	13.3%
	% of total	10.0%	3.3%	13.3%
Fair	Frequency	2	4	6
	% of group	13.3%	26.7%	20.0%
	% of total	6.7%	13.3%	20.0%
Good	Frequency	7	8	15
	% of group	46.7%	53.3%	50.0%
	% of total	23.3%	26.7%	50.0%
Very good	Frequency	2	2	4
	% of group	13.3%	13.3%	13.3%
	% of total	6.7%	6.7%	13.3%
Total	Frequency	15	15	30
	% of group	100.0%	100.0%	100.0%
	% of total	50.0%	50.0%	100.0%

All participants ($N = 30$) reported that web accessibility was crucial, despite disability concerns. Figure 4.18 shows that eight participants (26.7%) from the AAG compared with nine participants (30.0%) from the AUG expressed a similar opinion. 20% of participants in both the AAG and the AUG stated that it was essential. The remaining participants (one [3.3%] participant in the AAG compared with three [10%] in the AUG) believed that it was relatively important.

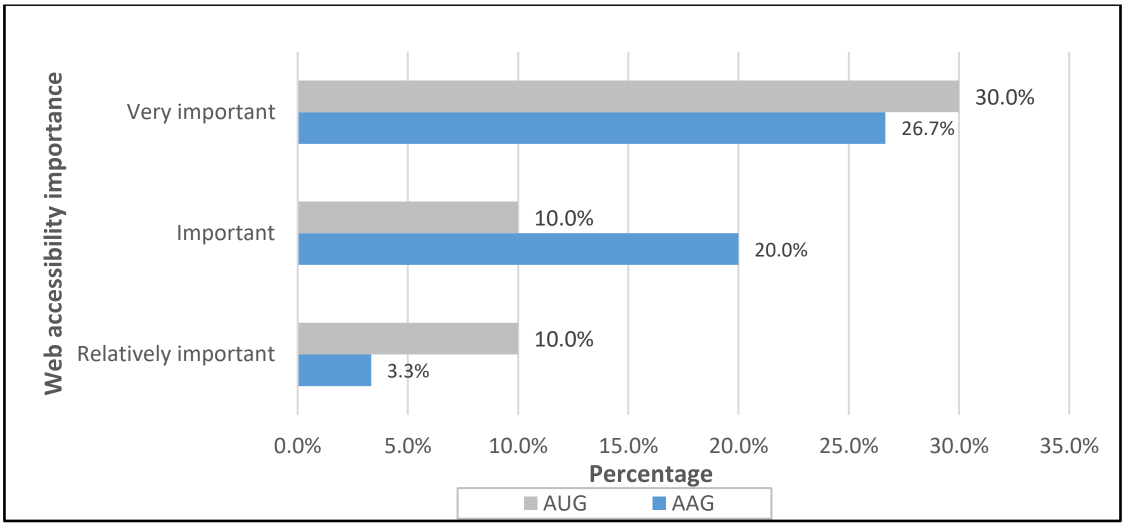


Figure 4.18: Participants' opinions on global web accessibility

Participants also expressed their opinions about web accessibility concerns. Results in Table 4.8 show that the majority of participants in both groups (n = 15) and of the total (N = 30) reported that web accessibility should be considered all the time (40.0% and 30.0% for AAG and AUG, respectively). One participant from the AUG and no one from the AAG selected the 'other' response or did not know the answer.

Table 4.8: Participants' consideration of web accessibility

Consider Web Accessibility		Group		Total
		AAG	AUG	
All the time	Frequency	12	9	21
	% of group	80.0%	60.0%	70.0%
	% of total	40.0%	30.0%	70.0%
When it is required	Frequency	3	4	7
	% of group	20.0%	26.7%	23.3%
	% of total	10.0%	13.3%	23.3%
I do not know	Frequency	0	1	1
	% of group	0.0%	6.7%	3.3%
	% of total	0.0%	3.3%	3.3%
Other	Frequency	0	1	1
	% of group	0.0%	6.7%	3.3%
	% of total	0.0%	3.3%	3.3%
Total	Frequency	15	15	30
	% of group	100.0%	100.0%	100.0%
	% of total	50.0%	50.0%	100.0%

Participants reported that they would consider web accessibility if they were involved in developing a website. Figure 4.19 shows that 10 (66.7%) participants from the AUG reported 'sometimes' and nine (60%) participants from the AAG reported 'always'. Of the total number of participants ($N = 30$), 33.3% who reported that they would 'sometimes' take web accessibility into consideration were in the AUG, and 30.0% who reported that they would 'always' take web accessibility into consideration were in the AAG.

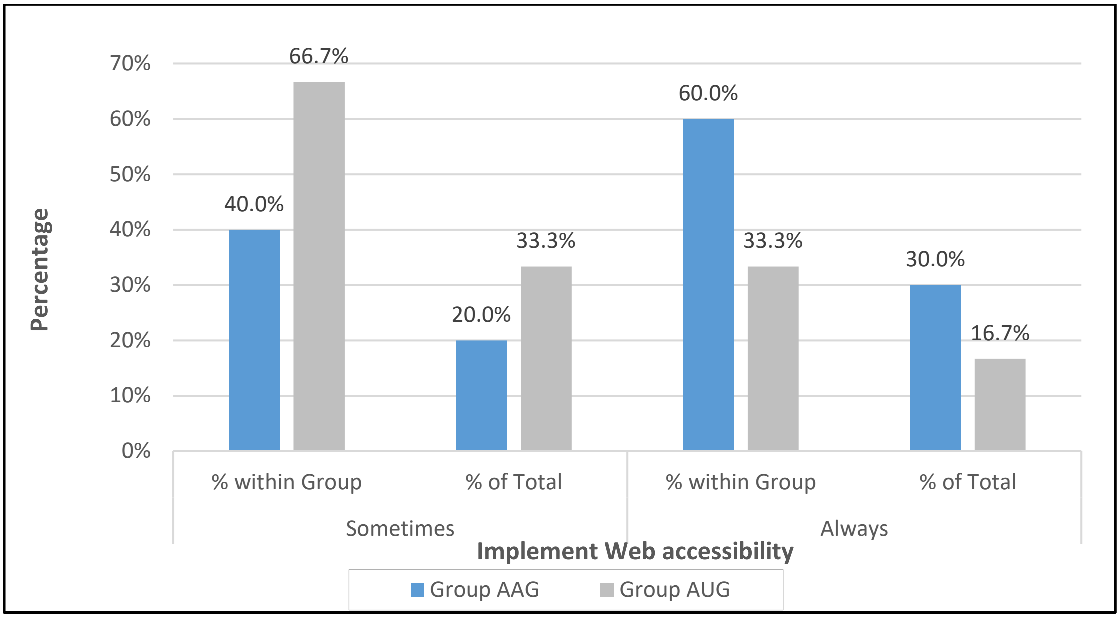


Figure 4.19: Web accessibility consideration when developing a website

In summary, results from the survey indicate that participants in the AUG had more web accessibility knowledge than those in the AAG. Although participants of both groups expressed their support for continual web accessibility awareness in the future, there was a minimum difference between the groups. The following sections provide more detailed information about participant capabilities.

4.2.4 World Wide Web Consortium Abilities

The pre-test results, shown in Table 4.9, show that half of all participants did not know what W3C stands for (three out of ten participants in AAG compared with out of ten in AUG). However, one-third of the total selected the correct answer (16.7% of the AAG and 13.3% of the AUG). Within the groups, 33.3% of participants from the AAG gave the correct response, compared with 26.7% from the AUG.

Table 4.9: Participants' understanding of the W3C meaning

W3C meaning		**Group**		**Total**
		AAG	**AUG**	
Web Wide Web Conglomeration	Frequency	0	3	3
	% of group	0.0%	20.0%	10.0%
	% of total	0.0%	10.0%	10.0%
World Wide Web Consortium	Frequency	5	4	9
	% of group	33.3%	26.7%	30.0%
	% of total	16.7%	13.3%	30.0%
World Web Wide Confederation	Frequency	1	2	3
	% of group	6.7%	13.3%	10.0%
	% of total	3.3%	6.7%	10.0%
I do not know	Frequency	9	6	15
	% of group	60.0%	40.0%	50.0%
	% of total	30.0%	20.0%	50.0%
Total	Frequency	15	15	30
	% of group	100.0%	100.0%	100.0%
	% of total	50.0%	50.0%	100.0%

When asked about the role of W3C (see Table 4.10), nine participants in each group reported that they did not know. Results show that five participants in the AUG (33.3% of the group and 16.7% of total participants) knew the correct answer, while three participants in the AAG (20% of the group and 10.0% of the total participants) knew the correct answer. Data from Table 4.9 and Table 4.10 show that the number of the participants in the AAG who did not know the answer to the meaning of W3C (nine) was the same as the number of participants who did not know its mission. Nonetheless, the number in the AUG who did not know the role changed from six to nine participants.

Table 4.10: Participants' understanding of the role of W3C

W3C Mission		Group		Total
		AAG	AUG	
Contributes to the evolution of the Web	Frequency	1	0	1
	% of group	6.7%	0.0%	3.3%
	% of total	3.3%	0.0%	3.3%
Develops HTML and mark-up standards	Frequency	2	1	3
	% of group	13.3%	6.7%	10.0%
	% of total	6.7%	3.3%	10.0%
All of the above	Frequency	3	5	8
	% of group	20.0%	33.3%	26.7%
	% of total	10.0%	16.7%	26.7%
I do not know	Frequency	9	9	18
	% of group	60.0%	60.0%	60.0%
	% of total	30.0%	30.0%	60.0%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

From the pre-test results, data indicate that most participants in both groups did not know of the W3C or its mission. Even when participants had been using the internet for more than six years, their knowledge about web accessibility was limited. The next section provides additional information about participants' experiences of accessibility guidelines.

4.2.5 Understanding and Use of Guidelines

Focusing on the participants' basic understanding of web accessibility guidelines, responses from the pre-test provided outcomes related to the meaning of WCAG and ATAG acronyms (Table 4.11). Surprisingly, results showed that, in both groups, half of the participants knew the meaning of the WCAG acronym and the other half did not (46.7%) or provided an incorrect response (3.3%). In the AAG, the majority did not know (53.3%), but 53.3% in the AUG knew the correct answer. In contrast, responses to the ATAG acronym showed that 20 participants in total (66.7%) did not know the answer and only one out of ten knew the correct answer, with only one participant from the AAG and two from the AUG whose responses were correct.

Table 4.11: WCAG and ATAG acronyms (before accessibility awareness session)

Acronym		**Group**		**Total**
		AAG	**AUG**	
WCAG				
Web Content Accessibility Guidance	Frequency	0	1	1
	% of group	0.00%	6.70%	3.30%
	% of total	0.00%	3.30%	3.30%
Web Content Accessibility Guidelines	Frequency	7	8	15
	% of group	46.70%	53.30%	50.00%
	% of total	23.30%	26.70%	50.00%
I do not know	Frequency	8	6	14
	% of group	53.30%	40.00%	46.70%
	% of total	26.70%	20.00%	46.70%
ATAG				
Accessibility Tools for Authoring Guidelines	Frequency	1	1	2
	% of group	6.70%	6.70%	6.70%
	% of total	3.30%	3.30%	6.70%
Authoring Tools Accessibility Guidelines	Frequency	1	2	3
	% of group	6.70%	13.30%	10.00%
	% of total	3.30%	6.70%	10.00%
Authoring Techniques Accessibility Guidelines	Frequency	1	3	4
	% of group	6.70%	20.00%	13.30%
	% of total	3.30%	10.00%	13.30%
None of the above	Frequency	0	1	1
	% of group	0.00%	6.70%	3.30%
	% of total	0.00%	3.30%	3.30%
I do not know	Frequency	12	8	20
	% of group	80.00%	53.30%	66.70%
	% of total	40.00%	26.70%	66.70%

Following the completion of tasks, only those who participated in the accessibility awareness session provided their opinions through the web-based survey on the use and understanding of the guidelines. Figure 4.20 shows that participants had mostly favourable opinions of the web accessibility guidelines. Of 15 participants in the AAG, 10 (66.7%) consulted the W3C materials (Figure 4.20a) and five (33.3%) did not. Sixty per cent of participants who consulted the guideline resources declared that the guidelines were complicated to understand (Figure 4.20b), four stated that they were not difficult and only one found them easy to apply (Figure 4.20c). The majority of participants (Figure 4.20d) stated that they would consider the accessibility guidelines in future web development.

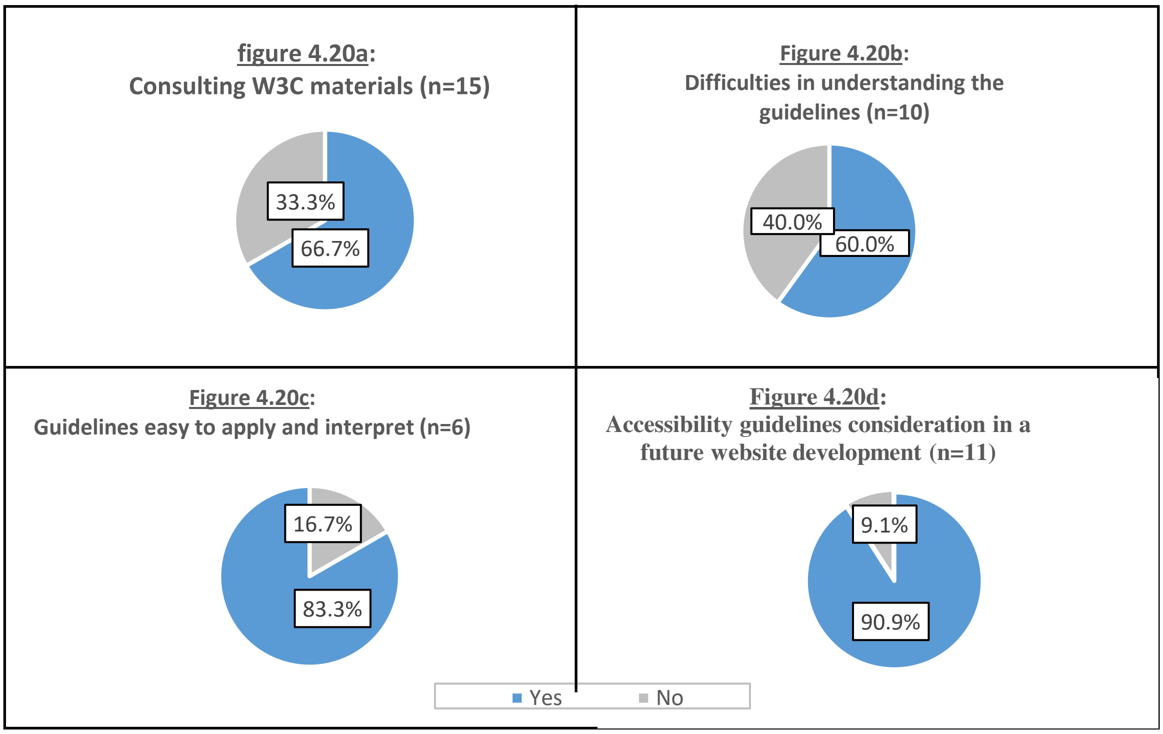


Figure 4.20: Participants' use and opinion of the web accessibility guidelines

From the pre-test results, it is apparent that the participants in this study were not familiar with the web accessibility guidelines WCAG and ATAG. Most were unaware that the standards (discussed in Chapter 2) were recommended for global web development and usage. Results from the survey also indicate that, on the whole, participants in the awareness group had some difficulties in web accessibility but their will indicated a desire to experiment with accessibility and they confirmed that they would consider guidelines in their future work. In addition to participants' understanding of and ability in web accessibility, it is important to understand their competency with web CMSs.

4.2.6 Web CMS Capabilities

4.2.6.1 Experience with web CMSs

Figure 4.21 shows that most participants had not heard of any web CMSs prior to the study. In the AAG, six participants (20.0%) knew about it compared with nine (30.0%) who did not. In contrast, in the AUG, 13 participants (43.3%) had not heard of any web CMS, compared with two (6.7%) who had.

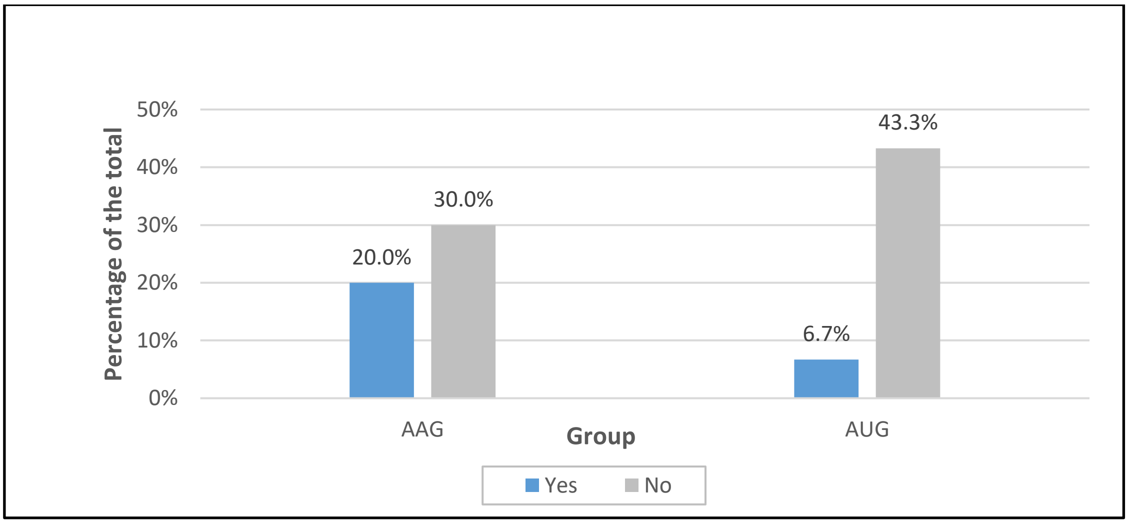


Figure 4.21: Participants' knowledge of a web CMS prior to the study

Of the participants who reported that they had heard of web CMSs, a negligible number from AUG listed three of the requested web CMSs (Table 4.12): WordPress, Drupal and Joomla or WordPress, Drupal and Magenta. Participants in the AAG provided 'other' responses, implying their unfamiliarity with web CMSs.

Table 4.12: Pre-test list of known web CMSs

Participant ID	Response
100000	Cannot recall names
100001	No idea
100002	I don't know any specific web CMS
100003	I can't name any
100012	Unsure
100014	N/A
200003	WordPress, Drupal, Joomla
200016	WordPress, Magento, Drupal

Likewise, in the post-test, the eight participants were asked to list three web CMSs they had heard of before the study. Results show that all participants listed a web CMS (Table 4.13). It is notable that from the pre-test (Table 4.12) to the post-test (Table 4.13), there were some amendments—except for participants 200003 and 200016 from the AUG, who listed the same web CMSs, the remaining participants named at least one web CMS.

Table 4.13: Post-test list of known web CMSs

Participant ID	Response
100000, 100012, 200003	WordPress, Joomla, Drupal
100001, 100002	WordPress
100003	WordPress, Duplo
100014	WordPress, Joomla
100016	WordPress, Magento, Drupal

In addition to their familiarity with any web CMS, the eight participants in both groups were asked to list three systems they had used before this study. Outcomes from the pre-test show that two from the AUG mentioned WordPress, Joomla and Magento, but no participants from either groups were able to name tasks they had completed with the system they had used.

In the post-test, the eight participants were asked the same question as that in the pre-test regarding their previous use of a web CMS. Results show a contrast between the pre- and post-tests. Four participants from AAG and one from AUG declared that they had used WordPress to create a website (Table 4.14). One participant from AAG did not remember, while the rest provided some web CMSs without specifying their use.

Table 4.14: Post-test list of web CMSs used before the study

Participant ID	Response
100001, 1000103, 100012, 100014, 200016	WordPress
100000	SharePoint
200003	WordPress, Joomla, OpenCart, ClipBucket, Zen Cart, Magento
100002	Other

The eight participants who declared that they knew of a web CMS indicated its benefits in the pre-test: 'Ease of access helps ensure that content is compatible in format to other elements in the website' (Participant 100003); 'Content can be saved and retrieved more effectively and efficiently' (Participant 100014); and 'CMS helps you in developing interactive websites without writing the code from scratch. It also enables the user to perform most of the task without knowing any coding language' (Participant 200003). Other participants claimed that they were easy to set up and were well-structured and managed as advantages of these systems.

In the post-test, participants cited universal access to the web, built-in features and helpful development tools as the main benefits of web CMSs. For example, Participant 100003 stated, 'Ease of construction. Most of the hard work of construction is done for you' and Participant 100012 stated:

> More accessibility for everyone—people can alter the size of the font, the colours have to pass a test for whether they are accessible and able to be interpreted, videos can be understood due to closed captioning, titles and headings are larger and can be read by a software or hardware that reads the screen for sight-impaired people.

Overall, results show that participants' opinions altered from the pre-test to the post-test. In the post-test, some were able to recall the name of a web CMS and cite its benefits, despite their prior lack of knowledge or usage.

4.2.6.2 Experience with WordPress

In addition to their experience with any web CMSs, the 30 participants were asked via the web-based survey to provide information related to their experience with WordPress. When asked about their opinion of system usage (Figure 4.22) and level of difficulty (Table 4.15), most participants found WordPress easy to use. In the AAG, 36.7% participants reported that it was a user-friendly system, 3.3% found it inconvenient and 10.0% did not provide an answer. A similar tendency was observed for the AUG in which 33.3% of participants agreed that WordPress was easy to use, 6.7% reported that it was difficult to use and 10.0% did not provide an opinion.

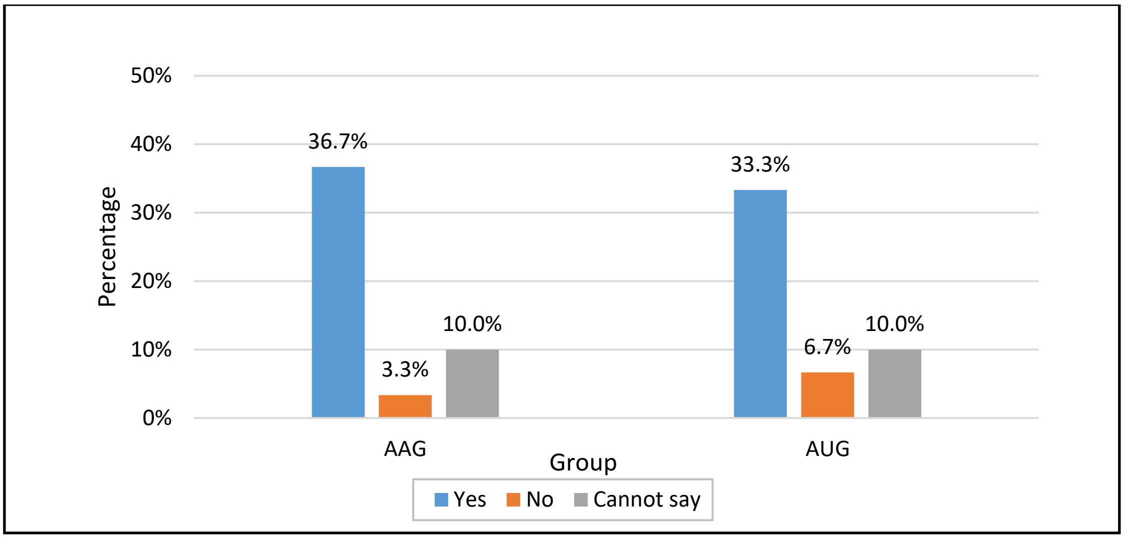


Figure 4.22: Participants' opinion on WordPress's 'easy' use

Participants who found WordPress difficult to use or those who could not decide (nine participants in total) related this to their unfamiliarity with the system and its features. They reported that difficulties were mainly related to table insertion, plug-in insertion, lack of computer skills and not understanding the system. Responses included 'Unable to select where I wished to write and had to go through all of the text to try and edit a word' (Participant 100001), 'Not sure because it was my first time and did not have much time to get myself familiarised with its tools' (Participant 200002) and 'Because I was not familiar in WordPress, I had to learn how to use it' (Participant 200010).

More than half the participants (53.3%) found that difficulties varied from task to task (Table 4.15), with more than three out of ten (33.3%) in the AAG and one out of five (20.0%) in the AUG. Those who responded with 'very hard', 'easy' or 'cannot say' were in the minority.

Table 4.15: WordPress level of difficulty when applying research tasks

Difficulty level		Group		Total
		AAG	AUG	
Cannot say	Frequency	2	3	5
	% of group	13.3%	20.0%	16.7%
	% of total	6.7%	10.0%	16.7%
Varied from task to task	Frequency	10	6	16
	% of group	66.7%	40.0%	53.3%
	% of total	33.3%	20.0%	53.3%
Easy	Frequency	2	4	6
	% of group	13.3%	26.7%	20.0%
	% of total	6.7%	13.3%	20.0%
Very hard	Frequency	1	2	3
	% of group	6.7%	13.3%	10.0%
	% of total	3.3%	6.7%	10.0%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

Tasks varied from page to page and participants used the system's features to perform them. To add content to pages, they were required to switch to the HTML text editor. Figure 4.23 shows participant responses, which indicate that most participants from the AAG (43.3%) did switch to the text editor, while nearly half of those from the AUG did not. In the AAG, all participants used the text editor mainly for the table.

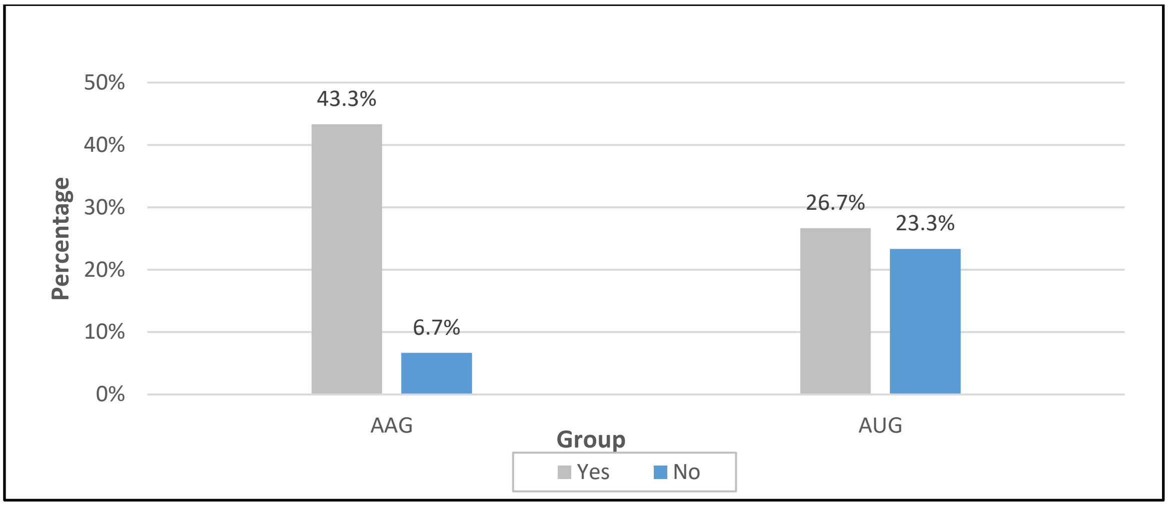


Figure 4.23: Participants who switched to WordPress's text editor

The nine participants who did not switch to the text editor attributed this to their inexperience, unawareness or ignorance: 'I don't know what it is' (Participant 100010), 'I don't know how' (Participant 200002) and 'It was a bit new and confuse when start to use this web page, that why I forget in detail to switch HTML editor' (Participant 200009).

Seventy per cent of participants declared that they could apply the accessibility requirement options provided by WordPress (Table 4.16). Eleven participants (36.7%) and 10 participants (33.3%) from AAG and AUG, respectively, reported that they achieved the requirements using WordPress. The remaining participants, nine in both groups, could not apply the requirements, with reasons including their lack of HTML skills and difficulty with the process and properties. Responses included 'I am not much familiar with the coding and other syntax' (Participant 100002), 'I didn't understand the process' (Participant 100010) and 'I wanted to change the colour of the images but could not figure out how to do it' (Participant 200014).

Table 4.16: Accessibility requirements applied with WordPress options

Requirement applied		Group		Total
		AAG	AUG	
Yes	Frequency	11	10	21
	% of group	73.3%	66.7%	70.0%
	% of total	36.7%	33.3%	70.0%
No	Frequency	4	5	9
	% of group	26.7%	33.3%	30.0%
	% of total	13.3%	16.7%	30.0%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

Most participants (70%) recognised that it was easy to identify the accessibility options in WordPress (Table 4.17). Four out of 10 in the AAG compared with three out of 10 in the AUG found that the WordPress options were not difficult to identify when adding content to the pages. The participants who found it difficult (30% in total) declared that their limited programming skills, their unfamiliarity with the system and the complexity of the system's structure were the primary reasons for these difficulties. Responses included 'Unfamiliar with procedure' (Participant 100013), 'The structure of WordPress is complex for accessibility' (Participant 200005) and 'It was a little bit complicated with new user as me, and in some task, you need to add information in specific space, which need to be practised and remembered' (Participant 200009).

Despite their assertions, all participants cited features they liked in WordPress, including its structure, functions, customisation and management control. Responses included 'I got the feeling it was set up so that once you knew what you were doing it would be fairly straightforward to use. One step at a time, adding various pieces of information to build the site' (Participant 100010), 'Ability to switch between Visual and Code. Saving drafts. Easily navigated tool set' (Participant 200012) and 'Layout of the finished page seemed simple. It seemed relatively simple to add content. It used tools I am familiar such as embedding and pasting, even though the videos did not work for some reason' (Participant 200014).

Table 4.17: Identification of WordPress accessibility options

Options easy to identify		Group		Total
		AAG	AUG	
Yes	Frequency	12	9	21
	% of group	80.0%	60.0%	70.0%
	% of total	40.0%	30.0%	70.0%
No	Frequency	3	6	9
	% of group	20.0%	40.0%	30.0%
	% of total	10.0%	20.0%	30.0%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

Participants also cited features in WordPress that they most disliked, including its numerous features, restricted functions and coding difficulties for those who had limited or no HTML experience. They also quoted manipulation issues such as adding plug-ins, navigating between themes or finding options when adding content to pages. Participant response included 'It requires familiarisation to use effectively, something which I lack. There do not seem to be individual features I have discovered that I overly dislike' (Participant 100000), 'I thought that the text editor within a page was quite limiting and was not very intuitive when it came to embedding various things' (Participant 100003), 'Needed prior knowledge of HTML coding. Difficult to add in a table. Could be a function where you can draw or paste in a table had to individually edit each page' (Participant 100012) and 'It requires to active some plug-ins. The themes are not diversity. You have to pay for some of them. It also requires a little bit of code knowledge' (Participant 200005).

Even with the difficulties mentioned, most of the 30 participants (73.3%) declared that they would recommend the use of WordPress (Table 4.18). In both groups, 36.7% of participants stated that they would recommend the system, while 13.3% and 10.0% in AAG and AUG, respectively, did not know if they would or would not recommend the system. In AAG, only four participants (26.7%) did not know, but 11 (73.3%) declared that they would endorse it. Similarly, 11 (73.3%) participants in the AUG reported they would endorse it, while three (20%) participants declared that they did not know.

Table 4.18: Participants' recommendations for WordPress

Recommend WordPress		Group		Total
		AAG	AUG	
Yes	Frequency	11	11	22
	% of group	73.3%	73.3%	73.3%
	% of total	36.7%	36.7%	73.3%
No	Frequency	0	1	1
	% of group	0.0%	6.7%	3.3%
	% of total	0.0%	3.3%	3.3%
I don't know	Frequency	4	3	7
	% of group	26.7%	20.0%	23.3%
	% of total	13.3%	10.0%	23.3%
Total	Frequency	15	15	30
	% of group	100%	100%	100%
	% of total	50.0%	50.0%	100%

In general, participants in both AAG and AUG were supportive of the use and recommendation of WordPress. Regardless of the issues and difficulties revealed by some participants, most valued its potential. They proclaimed that the system was user-friendly because it allowed easy access, they were able to identify and use the accessibility options and it provided a text editor to facilitate content structure and accessibility.

4.2.7 Summary

This section provided an overview of participants' skills and perceptions of the internet, accessibility and web CMSs from the recordings, the web-based survey and the pre- and post-tests. To summarise, it is apparent that participants had little knowledge of web CMSs and awareness of accessibility. The following section explores the effects of accessibility awareness on outcomes through observation of participant performance.

4.3 Accessibility Components and Tasks

The previous section described the distribution of participants in this study by groups (AAG and AUG) and by demographic characteristics such as gender and age. It also provided information relating to their accessibility knowledge, including accessibility guidelines and concepts, and their attitudes towards web CMSs and WordPress. This section scrutinises how the participants, in their respective groups, implemented the components required, completed tasks and delivered outputs.

4.3.1 Accessibility Components

To implement the requested components, participants were required to shift to WordPress's default editing modes (Visual editor and text editor).Video recording results, shown in Figure 4.24, reveal that all participants in the AAG shifted to the HTML text editor, compared with only 6.7% of the participants in the AUG.

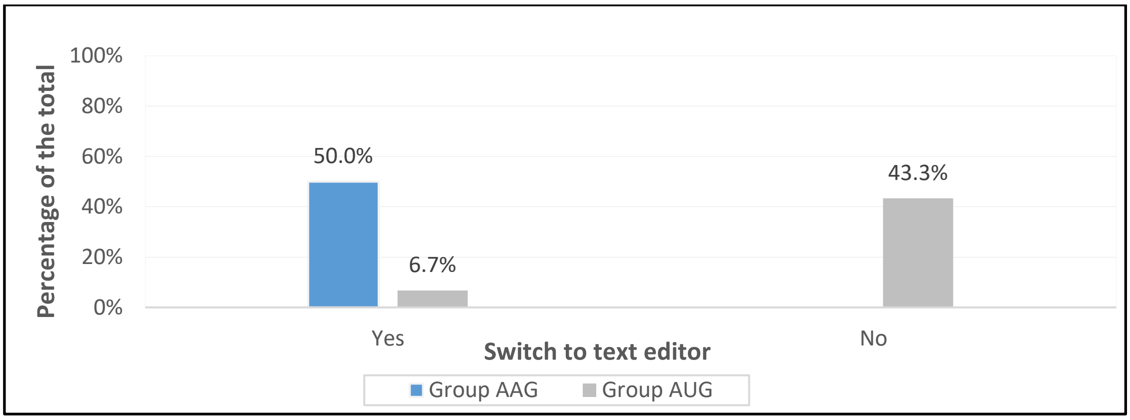


Figure 4.24: Change to WordPress text editor

Each participant was required to implement a total of 54 components into his or her website, accounting for a total of 810 components per group (n = 15). Results shown in Table 4.19 indicate that, via the text editor, participants in the AAG implemented more than half (425) of the components, most of them in the home page (125) and web CMS (111), whereas participants in the AUG applied only 149 components, mainly in the web CMS (129 components). Results also show that most of the components were not implemented in the web CMS page for both groups (129 components in AAG and 226 in AUG were not implemented).

Table 4.19: Components implemented by group for 15 websites

Page	Components required	Components implemented		Components not implemented	
		AAG	AUG	AAG	AUG
Home	210	125	24	85	186
Web CMS	240	111	14	129	226
Accessibility links	90	51	28	39	62
Accessibility video	105	52	30	53	75
Ask question	90	44	26	46	64
Contact us	75	42	27	33	48
Total	810	425	149	385	661

Table 4.20 shows that, in total, participants in both groups used WordPress formatting features for components derived from a combination of tasks and features. However, there was an apparent difference between the groups: participants in the AAG used 255 components from the system, while those in the AUG used only 81 components. The most frequently used components by AAG participants were those requested for the 'Web CMS' page (total of 81 components) and the least used were for the 'Ask a question' page. Conversely, participants in AUG used more components for both the home page and the web CMS page (19 components), while the least number of components (six) were used for the 'Ask a question' page.

Table 4.20: WordPress formatting used for implemented components

Page	Group	
	AAG	AUG
Home	78	19
Web CMS	81	19
Accessibility links	29	15
Accessibility videos	26	11
Ask a question	17	6
Contact us	24	11
Total	255	81

Results from the recording also show that, in total, only participants from the AAG used HTML codes for the components selected in this research. Results from Table 4.21

indicate that, for 15 websites, the participants used only a few HTML codes to implement the components. For instance, the home page requested 210 components for all participants in each group (six features for one page), but only 15 were implemented with HTML codes. Except for the home page and the web CMS page, the rest of the pages were implemented with fewer codes (six or less).

Table 4.21: Accessible HTML codes used for the implemented components

Page	**Group**	
	AAG	**AUG**
Home	15	0
Web CMS	17	0
Accessibility links	5	0
Accessibility videos	6	0
Ask a question	2	0
Contact us	4	0
Total	49	0

In general, participants in the AAG performed better than did those in the AUG. During the awareness session, they were advised to search online, to change to the text editor and to implement accessible HTML codes for the required components. The length of time spent online indicates their determination to find information to assist in developing accessible content. Even when participants in AAG recognised their limited or absent HTML skills and had never used WordPress, they provided positive outcomes with respect to implementing components via WordPress or HTML codes.

4.3.2 Task Completion

Table 4.22 shows the tasks completed by participants in both groups. In total, there were 330 attempts to complete tasks in each group. Scores showing ‘success’, ‘partial success’ and ‘failure’, as explained in Section 3.4.1, show that AAG participants succeeded in 163 attempts, failed in 104 and partially succeeded in 63, representing a 59.1% success rate. In contrast, participants in the AUG failed in 236 tries, succeeded in 88 and partially succeeded in six attempts, resulting in a success rate of 27.6%.

Table 4.22: Task completion by group

Group	Fail	Partial Success	Success	Total
AAG	104	63	163	330
AUG	236	6	88	330

An analysis was conducted to test whether the performance of correct tasks and components improved accessibility outcomes of the two groups. The independent sample *t*-test (as explained in Section 3.4.2) was conducted to accept or reject the following hypotheses:

H_0: The application of correct tasks and accessibility components does not lead to improved accessibility outcomes.

H_1: The application of correct tasks and accessibility components leads to improved accessibility outcomes.

Prior to the analysis, assumptions of independence, scale measurement, normality and homogeneity were examined, showing the following:

- Data were randomly and independently sampled (assumption of independence).
- The dependent variable (task completion) was on a continuous scale and the independent variable (group) was ordinal (AAG = 1 and AUG = 2) (assumption of scale measurement).
- Kolmogorov-Smirnov and Shapiro-Wilk tests were $p = 0.138$ and $p = 0.063$, respectively, which are both > 0.05 (as shown in Table 4.23). This result suggests that the dependent variable (task completion) does not deviate from normality (assumption of normality).

Table 4.23: Tests of normality

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
Task completion	0.140	30	0.138	0.934	30	0.063

Note: [a] Lilliefors significance correction; df = degree of freedom, Sig. = Significance

Results for equal variances show that this assumption was not violated. The *t*-test was used to examine whether the correct use of tasks and accessibility components improved accessibility outcomes. There was a significant difference in score *t* between the AAG and the AUG (see Table 4.25): $t(28) = 10.8$, $p < .05$, two-tailed (p = 0.0001), with AAG ($M = 10.07$, $SD = 4.95$) scoring higher than AUG ($M = -9.47$, $SD = 4.98$) (see Table 4.24). These results suggest that the correct application of tasks and accessibility components leads to improved accessibility outcomes. Thus, the null hypothesis was rejected and the alternative hypothesis was accepted.

Table 4.24: Group statistics

	Group	***n***	**Mean**	***SD***	***SEM***
Task completion	AAG	15	10.07	4.964	1.282
	AUG	15	−9.47	4.984	1.287

Note: n=sample number; SD = Standard deviation; SEM = Standard Error of the Mean

Table 4.25: Independent sample test

	Levene's Test for Equality of Variance		***t*-Test for Equality of Means**						
Task completion	***F***	**Sig.**	***t***	***df***	**Sig (2-tailed)**	**Mean difference**	***SE* difference**	**95% CI of difference**	
								Lower	**Upper**
Equal variances assumed	0.010	0.921	10.755	28	0.0001	19.533	1.816	15.813	23.254
Equal variances not assumed			10.755	28	0.0001	19.533	1.816	15.813	23.254

Note: F= test statistic for Levene's Test; Sig. = Significance; t=test; df = degree of freedom; SE = Standard Error.

4.3.3 Task Completion and Pre-existing Knowledge

A correlation analysis was conducted to assess the relationship between the participants' pre-existing HTML and accessibility knowledge and task completion. However, as the assumption of normality was violated, the alternative non-parametric test Spearman's rho (see Chapter 3) was used for HTML and accessibility knowledge. Prior to the test, analyses were performed to ensure that both variables were measured on an interval scale and that there was a monotonic relationship between them.

4.3.3.1 HTML knowledge

The hypotheses formulated for this test were:

H_0: Task completion is not dependent on pre-existing HTML knowledge.
H_1: Task completion is dependent on pre-existing HTML knowledge.

Table 4.26: Non-parametric correlations (using Spearman's rho) for pre-existing HTML knowledge and task completion

			Task Completion	**Pre-existing Knowledge (HTML)**
AAG	Task completion	Correlation coefficient	1.000	0.311
		Sig (2-tailed)		0.260
		n	15	15
	Pre-existing HTML knowledge	Correlation coefficient	0.311	1.000
		Sig (2-tailed)	0.260	
		n	15	15
AUG	Task completion	Correlation coefficient	1.000	−0.440
		Sig (2-tailed)		0.100
		n	15	15
	Pre-existing HTML knowledge	Correlation coefficient	−0.440	1.000
		Sig (2-tailed)	0.100	
		n	15	15

The strength of the relationship between task completion and HTML pre-existing knowledge was medium positive (r_s = .311) for AAG and negative (r_s = −.440) for AUG (Table 4.26). Statistical significance (AAG: sig. = .260; AUG: sig. = .100) was $p > 0.05$, suggesting that, for both groups, the correlation did not reach statistical significance ($p < .05$). Therefore, the null hypothesis H_0 was accepted and H_1 was rejected.

4.3.3.2 Accessibility knowledge

The hypotheses for this test were as follow:

H_0: Task completion is not dependent on pre-existing accessibility knowledge.
H_1: Task completion is dependent on pre-existing accessibility knowledge.

The strength of the relationship between task completion and pre-existing accessibility knowledge of accessibility was medium for AAG ($r_s = .410$) and strong for AUG ($r_s = -.553$) (see Table 4.27). Significance differed between the groups: the correlation was significant at .05 for AUG (Sig. (2-tailed) = .032), whereas the relationship between task completion and pre-existing accessibility knowledge was insignificant for AAG (Sig. (2-tailed) = .129). Therefore, the null hypothesis H_0 was accepted and H_1 was rejected for AAG, while the opposite was true for AUG.

Table 4.27: Non-parametric correlations (Spearman's rho) for pre-existing accessibility knowledge and task completion

			Task Completion	**Pre-existing Knowledge (HTML)**
AAG	Task completion	Correlation coefficient	1.000	0.410
		Sig (2-tailed)		0.129
		n	15	15
	Pre-existing accessibility knowledge	Correlation coefficient	0.410	1.000
		Sig (2-tailed)	0.129	
		n	15	15
AUG	Task completion	Correlation coefficient	1.000	−.553*
		Sig (2-tailed)		0.032
		n	15	15
	Pre-existing accessibility knowledge	Correlation coefficient	−.553*	1.000
		Sig (2-tailed)	0.032	
		n	15	15

Note: *Correlation is significant at the 0.05 level (2-tailed).

4.3.4 Summary

Outcomes from this section indicate that AAG participants performed better than those in AUG. Despite their limited HTML skills and their lack of experience with WordPress, the participants in this group had better use of HTML either as code or implementing it through the WordPress editor. Results also show that task completion was not dependent on pre-existing HTML and accessibility knowledge for the same group. The next section outlines how participants approached tasks and the progress they achieved.

4.4 Behaviour, Effort and Improvement

This section examines participants' performance and attitudes when undertaking tasks. The primary focus was to observe, via the recording, how each group, AAG and AUG, attempted to accomplish the tasks. Answers from before and after the awareness session were compared to observe any improvements and to determine whether there was a significant difference between the two groups. It also examines to what degree the awareness session changed HTML and accessibility knowledge, potentially affecting the outcomes.

4.4.1 Participant Behaviour

4.4.1.1 Web-searching behaviour

When searching for information on the web, participants used various strategies (shown in Table 4.28). AAG participants were mostly observed locating desired information using search terms (20 times in total), followed by navigating through links to other sites (six times), reformulating the search terms (six times) and opening multiple pages in the same browser to find information (three times). Participants in the AUG used similar strategies, but search terms were used to find information only five times, while reformulating search terms and navigating through links were observed one time each. None of the AUG participants opened multiple pages during the session.

Table 4.28: Online search strategies for specific required components*

Search techniques	Group	
	AAG	AUG
Uses search terms to locate information	20	5
Reformulates search terms	6	1
Navigates through links	6	1
Opens multiple pages	3	0

Note: *Components related to tables, links, videos and form

4.4.1.2 Online search terms

Participants used various terms or phrases to find the information needed. As shown in Table 4.29, while searching, some participants asked, 'how to' (Participants 100002, 100016 and 200005). Others used correct terms (Participants 100000, 100008, 100009, 100013 and 100015) or wrote words or phrases to seek the desired information (Participants 100003, 100012 and 100014).

Table 4.29: Examples of online search terms used

Participant ID	Examples
100000	HTML create an accessible table
100002	How to insert links into HTML?
100003	WordPress, setting a link within text
200005	How to create table in HTML?
100008, 100009, 100013, 100015	HTML code for table
100012	Adding HTML table into WordPress
100013	HTML code for unordered list
100014	Write codes table
100016	How to insert table in HTML?

4.4.1.3 Frequency of visited sites

Participants used various sites for gathering information about accessible HTML codes. As shown in Table 4.30, participants in both groups mostly used Google (127 times for AAG and 89 times for AUG) to find information related to the required tasks. The second most frequently visited site by AAG participants was W3Schools (50 times), while miscellaneous sites were visited 46 times and the remaining sites were visited a maximum of eight times. In contrast, AUG participants used WordPress 11 times and miscellaneous sites six times, but no participants used W3.org or forums. The average number of online visits varied between 40 times for AAG and 18.33 for AUG. The median followed a similar tendency—27 times for AAG, compared with five times for AUG.

Table 4.30: Number of visits for each online site

Resources	**Group**	
	AAG	**AUG**
Google	127	89
WordPress	5	11
W3Schools	50	4
W3.org	8	0
Forums	4	0
Miscellaneous	46	6
Total	240	110
Average	40.00	18.33
Median	27	5

4.4.1.4 Time spent searching

As discussed in Section 3.4.3, participants in AAG were informed about accessibility and HTML components, while those in the AUG performed tasks without awareness. Results in Table 4.31 reflect the difference between the two groups, showing that the participants in AAG spent more time consulting various online resources than those in AUG. Altogether, participants in AAG spent 140 minutes looking for information, mainly using Google (81 minutes) and W3Schools (28 minutes), while time spent visiting WordPress was negligible (1 minute). In contrast, AUG participants spent a total of 84 minutes, with the most time spent using Google (74 minutes), followed by WordPress (5 minutes) and other miscellaneous, but not useful, sites (4 minutes). However, none of them consulted W3.org or any forums.

Table 4.31: Total time (in minutes) spent consulting online resources

Resources	Group	
	AAG	AUG
Google	81	74
WordPress	1	5
W3Schools	28	1
W3.org	9	0
Forums	3	0
Miscellaneous	18	4
Total	140	84
Average	23.33	14.00
Median	13.50	2.50

4.4.1.5 Time spent on tasks

To accomplish tasks, the participants spent time developing each page according to different requirements, which varied from page to page, explaining the variability of time within and between page(s).

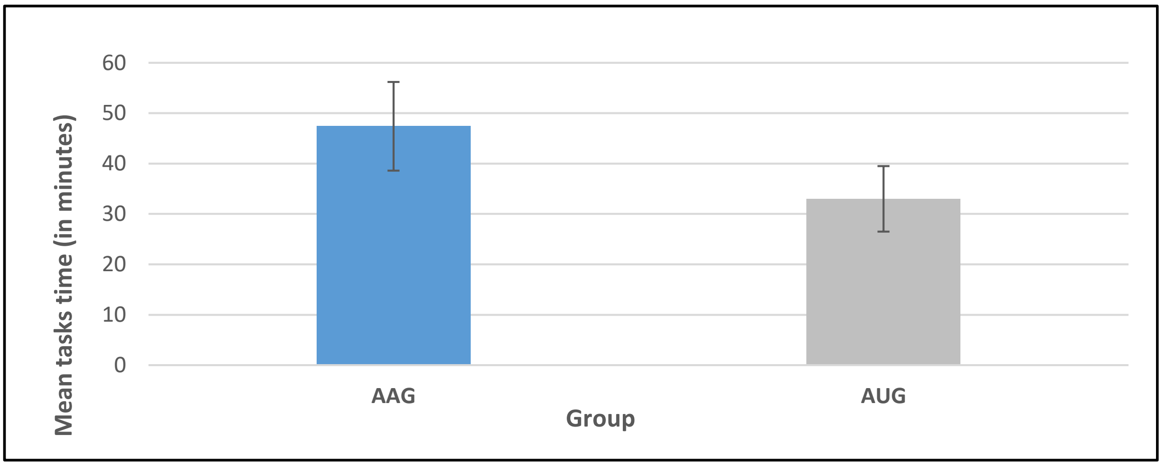
From video recordings, data shown in Table 4.32 indicate that, in total, participants in both groups spent more time on the web CMS page (375 minutes and 132 minutes for AAG and AUG, respectively) and less time on the contact page (35 minutes and 29 minutes for AAG and AUG, respectively). For each group, the maximum time spent by participants varied from high to low; for instance, in the AAG, some participants spent 17 minutes on a task that was completed by others in 8 or 3 minutes. Conversely, in the AUG, some participants completed tasks in a short period (1–3 minutes), while others needed more time.

On average, participants in the AAG spent 25 minutes on the web CMS page, while those in the AUG spent an average time of 9 minutes on the same page. The median values show that, for the contact page, half of the participants in the AAG were faster than 1 minute, while the other half was slower than 1 minute. In AUG, the median time observed for the same page was 2 minutes. Variability in time data, shown in Figure 4.25, also indicates that, with 95% confidence, the average time spent on tasks was significantly different between the two groups.

Table 4.32: Time (in minutes) on tasks per page and per group

Participant	Home	Web CMS	Acc. Links	Acc. Videos	Ask Question	Contact
AAG						
100000	15	30	2	3	5	1
100001	12	26	1	2	2	17
100002	6	17	4	4	17	2
100003	6	7	3	2	2	2
100005	13	61	2	0	7	1
100007	7	17	3	6	0	3
100008	4	33	1	1	4	2
100009	4	28	2	4	8	1
100010	10	9	5	1	3	1
100011	3	15	3	4	7	1
100012	2	22	3	2	1	1
100013	15	28	5	7	4	1
100014	15	35	7	4	6	1
100015	2	24	2	2	3	1
100016	26	26	3	3	1	1
Total	139	375	46	46	70	35
Mean	9.3	25.0	3.1	3.1	4.7	2.4
Median	7	26	3	3	4	1
SD	6.7	12.9	1.6	1.9	4.3	4.2
SE	1.7	3.3	0.4	0.5	1.1	1.1
95% CI	3.4	6.7	0.8	1.0	2.2	2.2
AUG						
200002	0	1	0	0	1	5
200003	3	25	3	1	1	0
200004	13	5	7	13	2	2
200005	2	14	2	0	9	0
200006	12	12	6	2	6	2
200007	4	11	5	2	15	1
200008	22	6	4	9	12	2
200009	6	1	2	6	21	1
200010	7	9	3	6	12	2

Participant	Home	Web CMS	Acc. Links	Acc. Videos	Ask Question	Contact
200011	2	3	6	3	6	0
200012	1	13	6	1	9	2
200013	6	16	5	11	9	1
200014	8	10	1	5	8	7
200015	4	3	7	2	9	2
200016	3	3	2	2	3	0
Total	93	132	59	65	123	29
Mean	6	9	4	4	8	2
Median	4	9	4	2	9	2
SD	5.7	6.7	2.3	4.0	5.5	1.9
SE	1.5	1.7	0.6	1.0	1.4	0.5
95% CI	3.0	3.4	1.2	2.1	2.9	1.0



Note: Error bars represent the 95% confidence interval)

Figure 4.25: Average time (in minutes) on tasks by group

4.4.2 Effort Made to Complete Tasks

Results from Table 4.33 indicate that, for most of the selected tasks, participants in AAG made a better effort than those in AUG. For the table, 10 AAG participants (representing 66.7% of the group) copied, pasted and adapted the code to develop the required table, while in the AUG, only one participant (6.7%) made a 'good effort'.

For the video, seven participants in the AUG (46.7% of the group) copied and pasted codes, compared with two participants in the AAG (13.3% of the group) who made a 'basic effort'. However, for the links task, most participants in both groups did not make any effort (60.0% and 100% for AAG and AUG, respectively).

For images, use of alt text was a failure for AUG because no one made a 'good effort' to provide alt text for images and only two participants made a 'basic effort'. However, most participants in AAG made a 'basic effort' for the home page image (86.7%) and the web CMS image (66.7%).

Table 4.33: Effort made for specific tasks

Task	Effort	Group	
		AAG	AUG
		Number (%)	Number (%)
Table	Good	10 (66.7%)	1 (6.7%)
	Basic	2 (13.3%)	1 (6.7%)
	No effort	3 (20.0%)	13 (86.7%)
Video	Good	3 (20.0%)	0 (0.0%)
	Basic	2 (13.3%)	7 (46.7 %)
	No effort	10 (66.7%)	8 (53.3%)
Links	Good	2 (13.3%)	0 (0.0%)
	Basic	4 (26.7%)	0 (0.0%)
	No effort	9 (60.0%)	15 (100%)
Image home page (alt)	Good	0 (0%)	0 (0%)
	Basic	13 (86.7%)	1(6.7%)
	No effort	2 (13.3%)	14 (93.3%)
Image web CMS (alt)	Good	0 (0%)	0 (0%)
	Basic	10 (66.7%)	2(13.3%)
	No effort	5 (33.3%)	13 (86.7%)

4.4.3 Most Difficult Tasks Perceived

Only participants from AAG were asked to rank the tasks in order of difficulty (see Section 3.4.1). The majority identified the table as the most difficult task (tables were ranked eight times in the first rank) and headings as the least difficult (headings were ranked six times in the last rank), as shown in Table 4.34.

Table 4.34: Tasks ranked from the most to the least difficult

Task	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Headings	1	0	1	2	6
Link	0	1	4	4	1
Video	0	4	3	1	2
Table	8	1	0	1	0
Page design	1	4	2	2	1

The total rank for each answer, shown in Figure 4.26, indicates that tables were the most challenging to understand (46 points), followed by page design (32 points), while the headings scored 18 points as the lowest score of all tasks. Similar results illustrated in Figures 4.13 and 4.14 show that most participants did not know the HTML codes to create columns or a table, explaining their difficulty with tables.

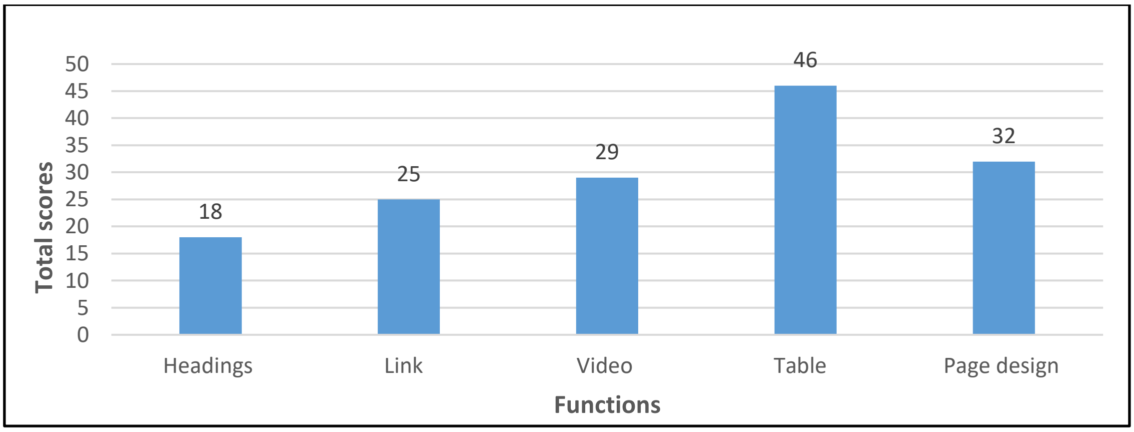


Figure 4.26: Participants' ranking for each answer choice

4.4.4 Improvement

4.4.4.1 Pre- and post-test answers

The participants in this study were asked to answer 17 similar in the pre- and post-tests (they were not informed about this similarity) to observe whether the awareness session influenced their knowledge and to identify changes in the answer provided before and after the awareness session. From pre- to post-tests sections 1 and 4 were slightly different; in section 1, the questions that were related to the participants' work and their involvement in web accessibility were not repeated in the post-test. In section 4, the question Q4.1 in the pre-test was eliminated in the post-test as it not affected by the training, Q4.1 and Q4.2 were alike except that they were related to their understanding of the benefits of Web CMS use before and while participating in this research (see Appendix A). Table 4.35 illustrates the different responses from both testing instruments. It shows the following results:

- Difference in answers from pre-test to post-test: On average, eight participants in the AAG answered questions differently from the pre- to post-tests (*SD* = 2). Twelve participants gave different responses to 'The role of W3C', which the maximum value in the group was compared with a minimum of four related to 'The correct approach in placing a comment in HTML document'. Similarly, AUG participants changed their responses from pre- to post-tests with a slight difference in mean (7) and standard deviation (3). Differences were highest for 'W3C acronym' and were lowest for 'HTML element that should be used for the topmost heading in a document'.
- Incorrect on pre-test to correct on post-test: Participants in AAG performed better than those in AUG. On average, five participants in AAG changed their answers from incorrect to correct compared with four in AUG. Most participants (10) in AAG improved their answers regarding the HTML code for the headings, while in AUG, most improvement was observed for the W3C acronym.
- Correct on pre-test to incorrect on post-test: On average, no participant in AAG changed a correct answer to an incorrect one. However, in the AUG, one participant changed the answer from correct to incorrect.
- Correct on pre-test to correct on post-test: Participants in the AAG preserved, on average, four similar correct answers between pre- and post-tests (*SD* = 4). AUG participants performed worse, with a mean of three correct answers (*SD* = 2).
- Incorrect on pre-test to incorrect on post-test: Between the pre- and post-tests, participants in both groups returned incorrect answers from the pre-test to the post-test, mainly for the HTML elements related to the topmost headings in a document, tables, hyperlinks and video.

Table 4.35: Pre-test to post-test answers

	AAG	AUG
	Mean (*SD*)	**Mean (*SD*)**
Questions answered differently from pre- to post-test	8 (2)	7 (3)
Incorrect on pre-test to correct on post-test	5 (3)	4 (3)
Correct on pre-test to incorrect on post-test	0 (0)	1 (1)
Correct on pre-test to correct on post-test	4 (4)	3 (2)
Incorrect on pre-test to incorrect on post-test	6 (4)	7 (4)

Note: SD = standard deviation; Table labels taken from (Brown, 2005)

In general, it can be seen that results were more significant for AAG. For all answers provided between pre- and post-tests, the participants in this group showed improved performance attributed to their perceived improvement in the post-test. To check this significance, a paired *t*-test was conducted to test the difference in means between pre- and post-tests for AAG.

4.4.4.2 Pre-test/post-test improvements

The paired *t*-test (briefly explained in Section 3.4.2) was used to test for differences between the pre- and post-tests for AAG participants' HTML and accessibility knowledge. The hypotheses formulated for this test were:

H_0: There is no difference in participants' HTML and accessibility knowledge before and after the awareness session.

H1: There is a difference in participants' HTML and accessibility knowledge before and after the awareness session.

Table 4.36: Paired samples statistics

	Mean	*n*	*SD*	Mean *SE*
HTML and accessibility knowledge post-test	10.20	15	2.833	0.732
HTML and accessibility knowledge pre-test	4.40	15	2.230	0.576

Note: n = sample number; SD =Standard Deviation; SE = Standard Error.

Table 4.37: Paired samples test

	Paired Differences					*t*	*df*	Sig. (2-tailed)
	Mean	*SD*	*SE* Mean	95% CI				
				Lower	Upper			
Difference in HTML and accessibility knowledge from pre- to post-test	5.800	2.484	0.641	4.424	7.176	9.042	14	0.001

Note: SD =Standard Deviation; SE = Standard Error, CI = Confidence Interval; Sig = Significance.

Results of the paired *t*-test, shown in Table 4.37, indicate that there is evidence ($t = 9.042$, $p = 0.001$) to suggest that participants experienced statistically significantly greater improvement when exposed to the accessibility awareness training session, as shown in Table 4.36 (mean = 10.20, *SD* = 2.8) than before the session (mean = 4.40, *SD* = 2.2) with a 95% CI [4.42, 7.18]. Given that $p < 0.05$ ($p = 0.001$), the null hypothesis was rejected.

4.4.4.3 Improvement measures

Table 4.38: Improvements observed from pre- to post-test

Participant		No Effect	Regressed Effect	Improvement
AAG	100000	10	1	6
	100001	10	0	7
	100002	10	0	7
	100003	10	0	7
	100005	10	0	7
	100007	12	0	5
	100008	11	0	6
	100009	11	0	6
	100010	15	0	2
	100011	10	0	7
	100012	10	0	7
	100013	11	0	6
	100014	12	0	5
	100015	15	1	1

Participant		No Effect	Regressed Effect	Improvement
	100016	10	0	7
	Total	167	2	86
	Mean	11.1	0.1	5.7
	Median	10	0	6
AUG	200002	11	2	4
	200003	10	0	7
	200004	11	1	5
	200005	10	2	5
	200006	14	0	3
	200007	11	4	2
	200008	13	0	4
	200009	15	0	2
	200010	13	0	4
	200011	16	0	1
	200012	9	0	8
	200013	10	1	6
	200014	12	1	4
	200015	12	0	5
	200016	15	0	2
	Total	182	11	62
	Mean	12.1	0.7	4.1
	Median	12	0	4

As illustrated in Table 4.38, from the pre- to the post-tests, most of the participants' responses to the 17 questions (from correct to correct or incorrect to incorrect = no effect) did not change. Participants in AAG scored 167 (mean = 11.1, median = 10), while participants in AUG scored 182 (mean = 12.1, median = 12). Two participants in AAG and six in AUG showed a regressed effect—from correct to incorrect—with no significant mean and median for both groups. However, all participants in both groups improved to some degree, especially those in AAG, which scored 86 (mean = 5.7, median = 6).

4.4.5 Summary

Results from this section suggest that AAG outcomes were better than those of AUG. The participants in AAG used some web searching techniques, more time and essential sites to perform their tasks—such behaviours were likely to have contributed to the improved performance. However, even when they had all sources available, the table was the most challenging task to complete for all participants in both groups. Nevertheless, AAG participants made a conscious effort and had greater improvement in perceived knowledge following the awareness session. Section 4.5 discusses participants' opinions and suggestions regarding the awareness session.

4.5 Feedback and Suggestions for the Awareness Session

4.5.1 Feedback on the Awareness Session

Most of the participants in AAG agreed that, in general, materials provided for the session improved their knowledge of accessibility (median = 2, interquartile range [IQR] = 4) and were 'useful' for their learning (median = 2, IQR = 4), as shown in Table 4.39. However, more than half of participants in AUG had a neutral response to the same question (median = 3, IQR = 1), while the other half claimed that it improved their accessibility knowledge. Participants of both of the groups disagreed about the relevance of the resources provided.

The abbreviations used in the tables of this section are as follow:

SD: Strongly Disagree
D: Disagree
N: Neutral
A: Agree
SA: Strongly Agree

Table 4.39: Overall views on the accessibility awareness materials

Effect of materials		*SD*	D	*N*	A	SA	Median	IQR
Improved knowledge of accessibility	AAG	0	0	1	10	4	2	4
	AUG	0	0	8	7	0	3	1
Useful for learning	AAG	0	0	2	9	4	2	4
	AUG	0	0	9	5	1	3	1
Unnecessary	AAG	5	6	2	2	0	1	2
	AUG	4	6	5	0	0	2	2
Irrelevant	AAG	5	6	4	0	0	1	2
	AUG	5	4	6	0	0	2	2

Note: IQR = interquartile range

In both groups, as Table 4.40 illustrates, participants had definite opinions about the clarity and simplicity of the awareness session resources. Nine and six participants in AAG and AUG, respectively, agreed that resources were ‘clear and understandable’ and ‘simple and useful’. No participant in either group found the materials to be ‘complex and incomprehensible’.

Table 4.40: Quality of accessibility awareness session materials

Quality of training materials		*SD*	D	*N*	A	SA	Median	IQR
Clear and understandable	AAG	0	1	2	9	3	1	4
	AUG	0	0	5	6	4	4	2
Simple and useful	AAG	0	1	2	9	3	1	4
	AUG	0	0	7	6	2	3	1
Short and coherent	AAG	0	0	4	8	3	2	4
	AUG	0	0	6	4	5	4	2
Complex and incomprehensible	AAG	1	9	2	3	0	1	2
	AUG	6	6	3	0	0	3	1

Opinions regarding the length of the session were similar. As seen in Table 4.41, participants disagreed about the length of time, with three and two participants in AAG and AUG, respectively, finding it ‘too short’ and three in the AAG finding it ‘too long’.

Table 4.41: Opinions on the accessibility awareness session time

Session time		*SD*	D	*N*	A	SA	Median	IQR
Too long	AAG	0	8	4	3	0	1	2
	AUG	3	6	6	0	0	2	1
Just right	AAG	0	2	4	9	0	1	4
	AUG	0	2	7	4	2	3	1
Too short	AAG	1	7	4	3	0	1	2
	AUG	0	8	5	2	0	2	1

Table 4.42 indicates that most participants in AAG agreed that the accessibility awareness session was conducted in an agreeable environment and in an appropriate place (median = 2, IQR = 4). However, more than half of the participants in AUG provided a neutral response related to agreeability of the environment (median = 3, IQR = 1). In both groups, participants disagreed on the fact that the environment was unsuitable (13 responses in each group).

Table 4.42: Opinions on the accessibility awareness environment

Environment		*SD*	D	*N*	A	SA	Median	IQR
Agreeable	AAG	0	0	0	11	4	2	4
	AUG	1	3	8	3	0	3	1
Appropriate	AAG	0	0	0	12	3	2	4
	AUG	0	0	4	6	5	4	2
Unsuitable	AAG	3	10	1	1	0	1	2
	AUG	5	8	2	0	0	2	1

Table 4.43 shows that very few participants in either group rated the awareness session as ‘unsatisfactory’. Thirteen AAG participants compared with 11 AUG participants strongly disagreed or disagreed for this option. In AAG, most participants (11) found that it satisfied their expectations (median = 2, IQR = 4), while those in AUG had a neutral response (nine of 15).

Table 4.43: Opinions on the accessibility awareness session expectations

Expectations		*SD*	D	*N*	A	SA	Median	IQR
Satisfactory	AAG	0	0	0	11	4	2	4
	AUG	0	0	9	4	2	3	1
Unsatisfactory	AAG	3	10	1	1	0	1	2
	AUG	6	5	4	0	0	2	2

4.5.2 Suggestions for Accessibility Awareness Materials

Participants were reluctant to provide detailed suggestions related to the accessibility awareness materials. Most agreed that simple written documents and instructions would be better instruments to use for the awareness session. Responses included 'I didn't utilise the videos due to the time constraints. I personally would prefer written documentation, however that is very much a personal preference as I know most people do like videos' (Participant 100000), 'If it can be organised and provided in a simple flyer format' (Participant 200008), 'It needs further simplification' (Participant 100009), 'I found the material interesting, but I guess it can be made a bit simple to understand' (Participant 200010) and 'It needs to be given in conjunction with contextual instructions on the task' (Participant 200014).

4.5.3 Summary

The AAG and AUG responses were favourable towards the importance of materials provided for their learning and knowledge. For most of the participants, the resources were useful and the time provided was just enough to finish their work in a pleasant environment, which influenced their positive expectations about the awareness session. Most of their suggestions focused on the documents' simplicity in written format, but they did not provide detailed suggestions for the other resources (e.g. the manual).

4.6 Chapter Summary

This chapter presented the research results for both the AAG and the AUG that were derived from the three different instruments used in this research: the recordings, the pre- and post-tests and the survey. The results, both qualitative and quantitative, revealed that the AAG performed better than the AUG in most tasks, despite their low HTML knowledge and the limited use of web CMSs prior to this study. When undertaking tasks, the participants in AAG demonstrated effective practices such as strategic web searching or use of the WYSIWYG content editor. They made mindful efforts and showed improvements in both their HTML and accessibility knowledge. AAG participants used more accessibility components and adequate time compared with those in AUG to accomplish their tasks successfully. From the pre- to the post-tests, AAG showed more improvements, which were demonstrated by the correct application of tasks and accessibility components, leading to improved outcomes.

To summarise, results show that accessibility awareness had a positive effect on participants' knowledge and perception of accessibility and, therefore, on the outcomes. This finding was the primary concern of this study, which is analysed in detail in the following chapter.

CHAPTER 5: ANALYSIS OF RESULTS

The previous chapter presented the research results obtained through the three selected instruments: participant activity captures, pre- and post-tests and web-based surveys, which were fully described in Chapter 3. This chapter analyses the results outlined in Chapter 4 to address the research questions that underpin this study. This chapter is structured to align with the order of participant involvement in this study: awareness raising, task performance, web search, completion of required work and achievement of outcomes that determined the effects of awareness. The final section summarises the key findings to answer the research questions in Chapter 6.

5.1 Raising Awareness

Raising accessibility awareness for participants was challenging because awareness affects not only the previous knowledge of participants but also their perceptions towards web accessibility concepts and insights. This section examines these concepts closely and identifies whether any concomitant changes in participants occurred following the awareness session.

5.1.1 Participants

Participants in this research were drawn from multiple educational fields, including from the university schools of education, business, science and arts and humanities. During the recruitment phase, participants were recruited based on age (18 years old or older) and experience in using web technologies (such as social media, online learning systems or wikis). As a result, 30 participants with different backgrounds were randomly assigned to either the AAG or the AUG.

In both groups, there was a notable gender imbalance, with a total of five females and 25 males participating in the study. It is difficult to determine the reason for females' unwillingness to participate in this type of study—even female students from the School of Science who were computer-literate and had appropriate skills declined to participate.

5.1.2 Participant Experience

This research considered participant experience using the web. Most participants in both groups reported that they had been using the internet for more than six years, primarily for study and other purposes (e.g. socialising or playing games). Their experience level in using the web reflected the period of use, and most participants self-evaluated their experience level as ranging from medium to very good.

As seen in the literature review in Chapter 2, the internet has evolved since its creation, and the number of users has increased worldwide, from 3.39 billion in 2005 to 3.58 billion in 2017 (Statista, 2019a) (Statista, 2019). The constant development of new technologies has provided increased opportunities to use the internet for diverse activities, including social networking and studying. The latter reflects the participants' primary use—it would have been unusual had the participants reported otherwise.

In most academic institutions around the world, students use the internet at an earlier stage. Given that it has become the centre for knowledge, culture, sharing and communication, a significant number of students used the internet for these purposes during their studies. The study period (from the primary to the secondary education) takes more than six years, meaning that the university students had been using the internet for at least this period, which explains the number of years reported by nearly all the participants in this study.

5.1.3 Previous HTML Knowledge

This section aims to establish the level of pre-knowledge that each of the participant groups demonstrated prior to undertaking the web CMS tasks. As described in Chapter 3, participants in both groups completed the same pre-test to establish their level of HTML knowledge.

Results provide a clear view of participant knowledge before the study. In terms of HTML, outcomes showed that the majority of participants in both the AAG and the AUG had limited experience with even the fundamentals of HTML.

There was a gap in participant mark-up skills between the two groups, depending on the specific topic. However, this gap was minor for some of the elements—for instance, 40%

of participants in the AAG and 36% in AUG could not identify the correct answer to the question asking which HTML tag did not require an end tag </> (Figure 5.1).

Q. 2.1. Which of the following elements does not need to be closed with a set of end tags (</>)?

<pre>

<b>

<hr>

<p>

<div>

I don’t know

Figure 5.1: Screenshot of HTML element that does not need an end tag (</>)

With respect to fundamental HTML skills, the participants in the AUG were to some extent more knowledgeable than those in the AAG. Interestingly, for the HTML table (which appeared to be the most challenging task), 6.7% of participants from the AUG selected the correct answer compared with only 3.3% of those in the AAG. For the HTML elements associated with text colour and embedding a video, participants in both groups provided similar answers, while for accessible HTML hyperlinks, AUG participants quickly selected a greater number of correct answers, as observed in the recordings.

A well-structured and accessible HTML document requires ‘the use of appropriate header Markup (<h1>–<h6>), table headers, explicitly associated labels for form elements, and alternative text for images explicitly associated labels for form elements, and alternative text for images’ (Shelly & Young, 2007, p. 2). The thoughtful application of knowledge of both HTML and accessibility guidelines should lead to improved accessibility outcomes. Prior knowledge has been demonstrated as a potential factor for success in learning and accomplishment in the education field. The focus of this research is to explore the concept that increasing an individual’s knowledge in a given domain—in this case, using HTML to improve accessibility—should lead to a measurable improvement in the application of that knowledge. According to van Riesen, Gijlers, Anjewierden, and de Jong (2018):

> Students with little prior domain knowledge who participate in inquiry learning use less sophisticated strategies and need more experiments to reach conclusions than their

> more knowledgeable peers, who employ more well-structured goal-oriented inquiry strategies. (p. 1329)

In particular, the findings of Alexander and Judy's (1988, as cited in van Riesen et al., 2018) work aligns with the those of this research with respect to the influence of previous knowledge and other concept, used in this research on component implementation and task completion.

5.1.4 Familiarity with Accessibility Concepts

Participants in this research were largely unfamiliar with the concept of accessibility. Most of those in the AAG had limited pre-existing knowledge, whereas more than half the participants in the AUG reported having a reasonable level of accessibility knowledge. Materials related to accessibility, guidelines and systems were presented in the awareness session, during which participants in both groups were exposed to new concepts to enhance their understanding of web accessibility. In their self-evaluation at the end of the study, participants acknowledged the change in their views and understanding of web accessibility. In both groups, participants reported that the application of accessibility principles in web content should be considered an essential element of web authoring. They declared that accessibility should be used all the time and be a constant consideration for everyone—this was apparent in their willingness to consider accessibility in their future website development. This assertion aligns with the literature that supports the promotion, awareness and inclusivity of accessibility (Abou-Zahra & Henry, 2010; P. Brophy & Craven, 2007; Giraud, Thérouanne, & Steiner, 2018; Yesilada et al., 2012).

Besides accessibility awareness, most participants had been unfamiliar with the W3C prior to this research. Most participants in both the AAG and AUG provided an incorrect answer—given their limited skills in accessibility, it is not surprising that they were unfamiliar with the organisation and its role. The role of the W3C and its contribution to developing accessibility guidelines was poorly understood, which was expected given that, apart from true web technicians and developers, practically no one has heard of the W3C.

Responses regarding accessibility guidelines delivered consistent information that consolidated the previous results. The participants were unfamiliar with WCAG and

ATAG guidelines, with half of the participants failing to respond correctly to these acronyms. However, the remaining participants from both groups selected the correct answer—this was possibly due to the nature of the closed questions, which can lead to biased responses (Connor Desai & Reimers, 2018) or to the selection of a predefined answer without having an opinion or knowledge about the subject. Although some participants in both groups correctly answered questions about WCAG and ATAG, further analysis could establish whether pre-test responses were simply educated guesses and corrected post-test responses were the result of educated guesses becoming actual knowledge. Guesses could also be determined from recordings and outcomes because participants, mostly those in the AUG, failed to implement some or all of the simple guidelines (such as headings and colours).

5.1.5 Accessibility Awareness

Raising awareness about accessibility and its implications was the ultimate goal to improve participants' insight and knowledge, particularly for those in the AAG. The diversity of disciplines from which the participants came was one of the motivations for the content of the awareness session (see Figure 5.1). During the session, the aim was to sensitise both groups to accessibility issues faced by people with disabilities and to expand participant knowledge about accessibility concepts. The AAG received additional information related to how to implement HTML to ensure minimum accessibility and to increase awareness about the importance of the guidelines (as explained in Chapter 3). One of the goals of this research was to determine the importance of awareness through the provision of training materials in changing participants' opinions.

Results from a five-point Likert scale showed that most participants in the AAG had favourable opinions towards accessibility awareness session in terms of experiencing a significant change in their perception of accessibility and having improved knowledge and skills. Additionally, participants felt favourably towards the clarity of session materials, appropriateness of session level, time allocated to the awareness session and having their expectations met. In fact, 'The foundation of any kind of commitment to web accessibility is awareness of the issues. . . Most accessibility errors on websites are the result of lack of awareness, rather than malice or apathy' (WebAIM, 2016, para. 12). The lack of accessibility awareness in any field reflects the lack of accessibility. A reasonable amount of time spent on accessibility awareness improves skills and leads to significant outcomes. Raising accessibility issues among all stakeholders would help to meet the W3C goal of ‘accessibility for all’, rather than accessibility for some.

Figure 5.2 provides a visual demonstration of the approach used in this study to raise accessibility awareness in both groups (see Chapter 3 for a detailed description of each component). The orange line indicates that AUG participants received an introduction to the basics of the web and some background information on web accessibility and the role of web CMSs. However, these participants were not given examples of a how to apply HTML to ensure accessibility; therefore, awareness raising for this group was more conceptual than applied. As the blue line indicates, the AAG group received the full awareness training, including some key examples of how HTML may be used to enhance content accessibility.

[redacted]

Figure 5.2: Session awareness themes

(Pictures Sources: The Web:(Hinton, 2016) ; Accessibility: (Baird, 20015); Web CMS: (Dionach, 2011); HTML codes:(Tech Buzz, 2010) .

5.2 Task Completion

The participants in this study were asked to complete a series of tasks that required them to apply HTML in a way that ensured accessibility. Hence, the complexity of that task would play a role in their ability to complete it successfully in the short period they were given (two hours). In the context of this thesis, task complexity refers to the difficulties participants faced in implementing components in a way that ensured accessibility.

During the development process, participants in the AAG implemented more components than did those in the AUG. During the process of completing their tasks, most participants in the AAG opted to use the system's text editor rather than its visual editor, while participants in the AUG made little to no use of text editor functions. The visual editor is 'the default mode and looks very similar to a word processor. The visual editor icons allow you to format text, change font alignment, insert bulleted and numbered lists, and more' (WordPress, n.d) (see Figure 5.3a). Unlike the visual editor, the text editor (shown in Figure 5.3b) allows the user to write HTML into the editor and provides essential HTML elements in the form of buttons in the top bar of the editing mode (WPBeginner, n.d). In contrast to participants in the AUG, those in the AAG effectively used the text mode while completing their tasks. The visual mode was also used by both groups, with some degree of difference in use and behaviour observed during website development. AAG participants used the visual mode to copy the provided text and add the formatting shown in the taskbar of this mode; otherwise, they used the visual mode to implement the other features using HTML.

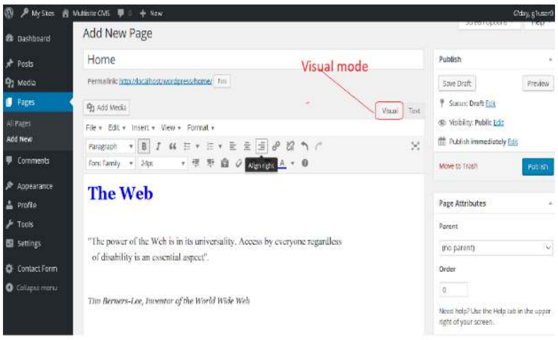


Figure 5.3a: WordPress visual mode

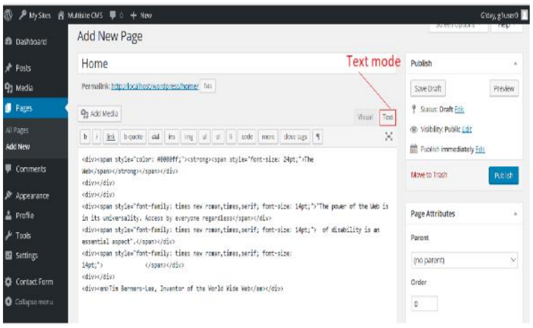


Figure 5.3b: WordPress text mode:

Figure 5.3: WordPress visual and text editor

By using WordPress editor, participants inserted the required components, with completion depending on the approach they used and the complexity of the tasks. The selected components were related to images, structure, hyperlinks, videos and tables.

5.2.1 Image Insertion

WordPress offers three possibilities for adding an image and its attributes: adding and editing an image in the Media Library (Figure 5.4a), inserting an image into a page using Insert Media (Figure 5.4b) or using the Featured Image option in the created page, which takes users to the Media Library where attributes may be added (Figure 5.4c).

The system's options suggest all the possibilities for inserting necessary attributes for the required components of the images. However, the research showed that all the participants in the AUG (100%) simply inserted images without any attributes. In contrast, nearly all participants in the AAG attempted to insert the image attributes in the home page—for example, 13 of the 15 participants in AAG added alt text to the image shown in Figure 5.5, and 10 out of 15 added alt text to the image shown in Figure 5.6.

Figure 5.4a: Upload/edit image in Media Library

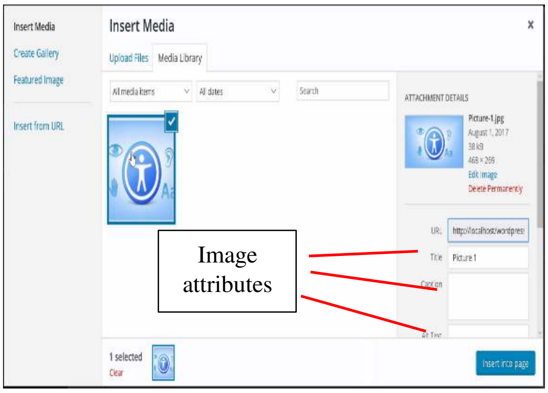


Figure 5.4b: Insert image with Insert Media

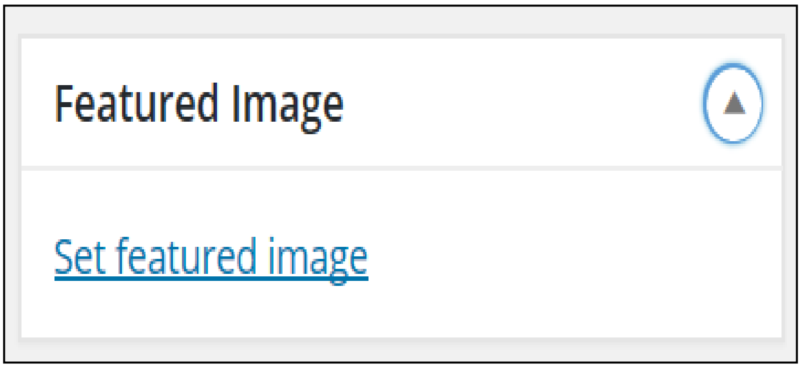


Figure 5.4c: Insert image from the created page

Figure 5.4: Different ways to add image attributes

Figure 5.5: Image inserted into the home page(Techcrunch, 2017)

The various alt texts added by AAG were as follows:

- Web accessibility: Participants 100011 and 100015.
- Types of disabilities: Participants 100001, 100003, 100007 and 100010.
- Human: Participants 100009 and 100010.
- Access: Participant 100008.
- Accessibility for all: Participant 10005.

Participant descriptions of this image included the following:

- ‘A picture of a man in the middle surrounded by an eye, an ear, a hand and upper ‘A’ and lower ‘a’ to represent disabilities’ (Participant 100001).
- ‘A picture of a man in the middle encircled by four pictures representing different types of disabilities’ (Participant 100003).
- ‘A picture with a man in the middle surrounded by four types of symbols’ (Participant 100007).
- ‘This picture has blue square and one man inside the blue circle’ (Participant 100008).
- ‘Blue rectangle with white man in blue circle and a hand, ear, and an eye, and capital and small letter a’ (Participant 100009).
- ‘A picture of a man in the middle surrounded by four types of perception’ (Participant 100010).

- ‘Different types of accessibility. Vision, hearing, touching, reading and talking’ (Participant 100011).

Figure 5.6: Image inserted into the web CMS page(Centre Algarve, 2014)

Participants were required to insert a second image (Figure 5.6) into the web CMS page based on similar principles, with identical outcomes as that of the first image. For instance, the participants in AAG added the image alternative text as follows:

- Accessibility: Participants 100001, 100009 and 100011.
- Access: Participant 100008.
- Accessibility for all: Participants 100005, 100007 and 100011.
- Person in wheelchair: Participant 100013.
- Sign of people with special needs: Participant 100015.
- Let’s make it accessible: Participant 100016.

Their image descriptions were:

- ‘Accessibility for all image—outline of a person in wheelchair with the text “Accessibility for all” surrounding him’ (Participant 100001).
- ‘The disabled symbol inside a circle with accessibility for all written above and below it’ (Participant 100003).
- ‘All the people should have equal access to the web’ (Participant 100005).
- ‘A man on a wheelchair’ (Participant 100007).

- ‘This picture has blue square and one man inside the blue circle’ (Participant 100008).
- ‘A white square with a dark blue circle having a picture of wheelchair inside it’ (Participant 100009).
- ‘White signal of a man in wheelchair in blue circle’ (Participant 100011).
- ‘Person in wheelchair with writing’ (Participant 100013).
- ‘Person sitting on wheelchair with special needs’ (Participant 100015).

Some participants in the AAG added alt text to the inserted images using recommended practices, such as the use of short words or brief description of images. However, the alt text information provided by some participants was somewhat uninformative or out of context (e.g. ‘human’ for Figure 5.5 and ‘access’ for Figure 5.6). Alt text is an image attribute attached to an image that provides valuable information, and it must be succinct, descriptive and accurate. It ‘should do two things: (1) briefly identify the non-textual element to which it is attached, and (2) provide access to the functionality represented by that element’ (Slatin, 2001, p. 78). A closer inspection of participants’ alt texts shows that all of them were aware of the presence of alt text for images, as stated by W3C guidelines, but they were not entirely aware of its benefits or best practice usage.

Given that no participants in the AUG added alt text to either image, the participants in this group failed to satisfy Guideline 1.1.1 of WCAG 2.0 (described in Section 2.5) or to provide accessible images in their websites, even when the interface of the web CMS provided a field for supplying this information.

The content of the image description, which provides greater detail about the image beyond that provided by the alt text, is much longer. Image descriptions should include the image location, text, surroundings and other features. AAG participants attempted to include some of these features, implying that they at least considered the importance of image attributes, even if the main goal was to change practice and perform better. Image descriptions were provided but were not sufficiently descriptive, seen in the use of interchangeable words such as ‘picture’ instead of ‘image’, which has different meanings for different people. Descriptions fell into three categories:

- Descriptive: Accurate and detailed information about the image content, such as ‘A picture of a man in the middle surrounded by four types of perception’

(Participant 100010) and 'The disabled symbol inside a circle with accessibility for all written above and below it' (Participant 100003).

- Informative: Some elements provided that were insufficient to describe the image, such as 'Different types of accessibility. Vision, hearing, touching, reading and talking' (Participant 100011) and 'A white square with a dark blue circle having a picture of wheelchair inside it' (Participant 100009).
- Uninformative: Ambiguous information about the image content, such as 'This picture has blue square and one man inside the blue circle' (Participant 100008) and 'Person in wheelchair with writing' (Participant 100013).

The categories of 'descriptive', 'informative' and 'uninformative' were derived from the work of Hollink, Schreiber, Wielinga, and Worring (2004), who classified the approaches individuals take in describing images, with categories being either conceptual or perceptual. Information about the content of the image may be general, specific or abstract or describe visual characteristics such as colours and shapes (Hollink et al., 2004). Bernardi et al. (2016) adds that the visual aspect of an image requires a complete understanding of the image to describe it adequately. He states that 'A good image description, in contrast, has to be comprehensive but concise (talk about all and only the important things in the image) and has to be formally correct, i.e., consists of grammatically well-formed sentences' (p. 4970).

Similar to this categorisation concept, the researcher categorised descriptions to identify participants' understanding of image attributes and to determine how the awareness session influenced their learning. AAG participants attempted to describe images by including specific elements that were relevant to image accessibility, but some of them were unable to provide accurate and extended descriptions for users of screen readers. Given that all AAG participants attempted to add alt text and image descriptions and were aware of the importance of these attributes for people with visual impairments, particularly those with congenital blindness who are completely dependent on assistive technologies, the benefits of the awareness training session were apparent.

Providing an image description is difficult because standards and rules about image descriptions are lacking. However, tools such as the Image Description Assessment Tool can help in assessing image descriptions. This tool provides an image description and a text-to-speech of the image uploaded into the system (as shown in Figure 5.7), but it needs a process to automate it (Nganji, Brayshaw, & Tompsett, 2013). It may be that future iterations of web CMSs may have not only a default input option for providing alt text but a built-in tool for creating appropriate descriptions of the image and its content. As an alternative to such technological solutions, the best approach may be for organisations using large amounts of visual content in their web materials to conduct training on the rationale and procedure for describing images in websites.

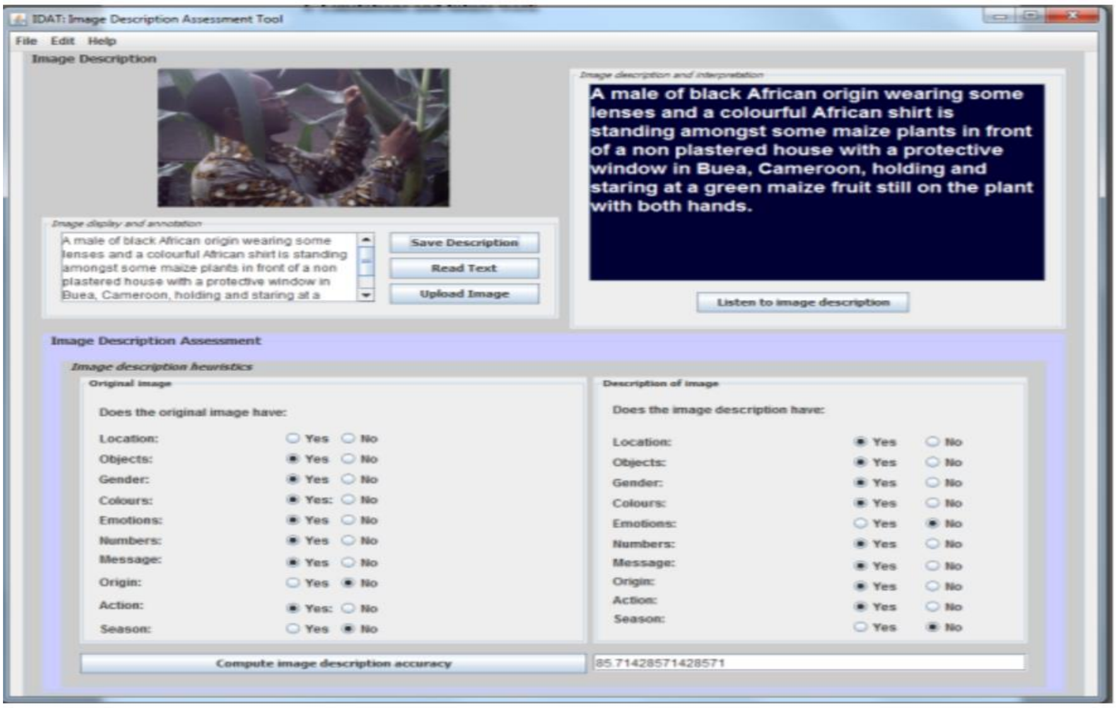


Figure 5.7: Image Description Assessment Tool for assessing accuracy of image descriptions(Nganji et al., 2013, p. 11)

Providing alt text or long descriptions are basic elements of web accessibility that even novices may understand and apply; however, as some descriptions indicated, writing an accurate description of an image or picture that is simple to interpret and understand is not always easy. Overall, most of the participants in AAG, in contrast to those in AUG, were aware of the usefulness of alt text and image descriptions for all users. Their attempt to deliver meaningful descriptions, even those with ambiguities, was a positive accomplishment because it implied that they had understood the aim and role of recommended practices, with their consequent benefits for accessibility.

5.2.2 Content Structure

Participants in this study were required to enhance website content in such a way that it was accessible and structured logically. As outlined previously, WordPress offers two modes (visual and text) for setting up the structure of web content such as headings, paragraphs, fonts, text colour, lists and hyperlinks. In its visual mode, WordPress provides a toolbar (see Figure 5.8) containing various options, similar to those of Microsoft Word, which participants used to introduce most of the elements for styling and formatting the content of their websites without having any HTML knowledge (i.e. using the WYSIWYG interface).

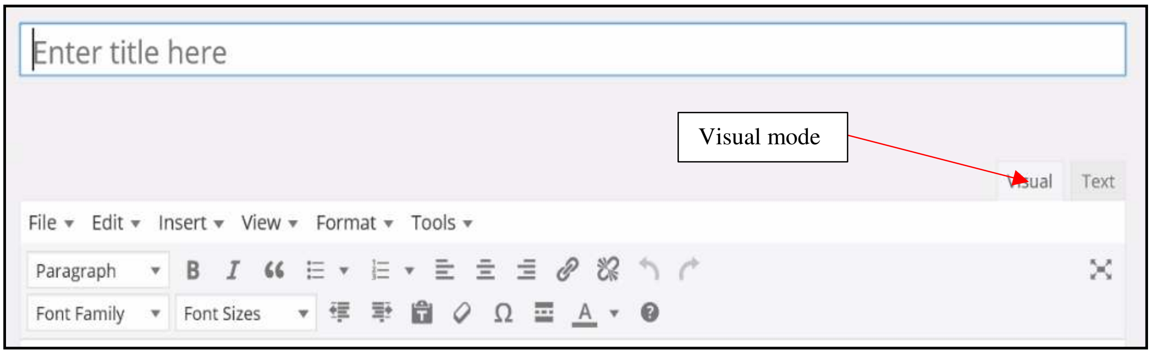


Figure 5.8: WordPress toolbar in visual mode

Conversely, text mode suggests HTML elements that participants can use to create lists or quotes, link text to other elements (see Figure 5.9) or write required HTML codes.

Figure 5.9: WordPress toolbar in text mode

When adding content to each page, most of the participants from both groups used the visual mode, with a few using the text mode, specifically those in AAG. The required HTML structural tags (such as headings, paragraph or fonts) were implemented in each page in a similar context but in different ways.

5.2.2.1 Headings

Most of the participants in AAG added the headings for all six pages in their websites. Records showed that half of them used the <h1> tag for the title pages (‘Ask a Question’ and ‘Contact us’ pages) compared with none of the participants in AUG, who failed to add headings to the title of the ‘Accessibility Videos’, ‘Ask a Question’ and ‘Contact us’ pages, instead copying and pasting the provided content as it was. AAG participants added the HTML <h1> tag by using the ‘Paragraph’ toolbar option in WordPress’s visual mode (Figure 5.10a) or by switching to text mode and implementing the required tags directly as HTML (Figure 5.10b).

The recordings showed that participants implemented the heading <h1> and the subheadings <h2> and <h3> in the following ways:

- Using the ‘Paragraph’ option in the visual mode toolbar (Figure 5.10a)
- Shifting to text mode to implement headings and subheadings (Figure 5.10b)
- Applying bold font to headings and subheadings (Figure 5.10c)
- Applying text size to titles (Figure 5.10d)
- Combining options (e.g. font family, font size and <h1>)
- Using the incorrect order in the hierarchy (e.g. <h3> before <h2>).

The participants in AAG were aware of the role of headings in the pages they created. Most of the participants in this group implemented headings appropriately using the visual or the text mode for all pages, but a few failed to apply the heading for the ‘Ask a Question’ page, which may have resulted from this page containing only a form rather than any written text. All of the participants in AUG failed to add titles to the final three web pages (‘Accessibility Videos’, ‘Ask a Question’ and ‘Contact us’). However, for the first three pages (‘Home’, ‘Web CMS’ and ‘Accessibility links’), participants attempted to differentiate the page titles or subheadings by using bold text, different font families or sizes or a combination of these options rather than selecting a correct heading style.

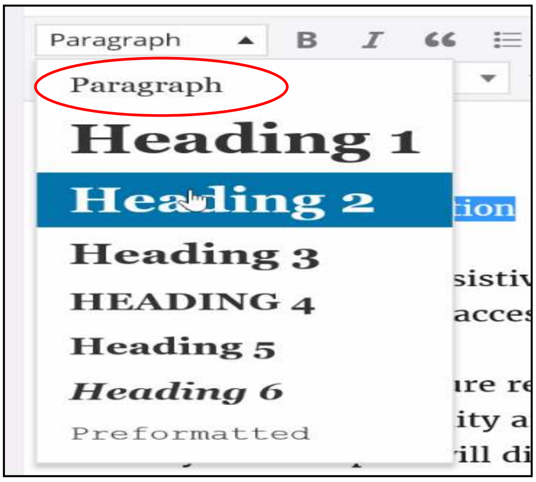


Figure 5.10a: Paragraph option for headings

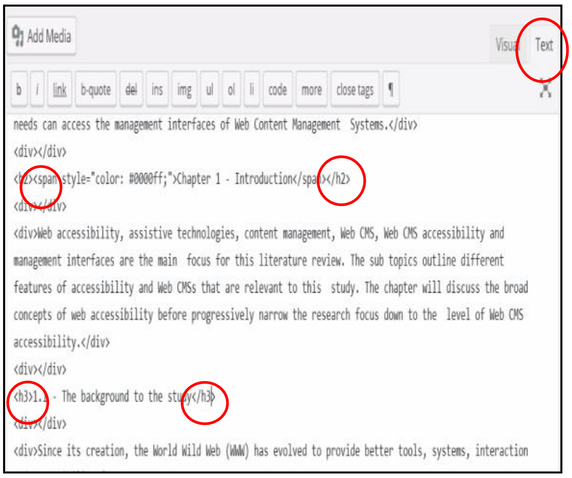


Figure 5.10b: Text mode to implement headings

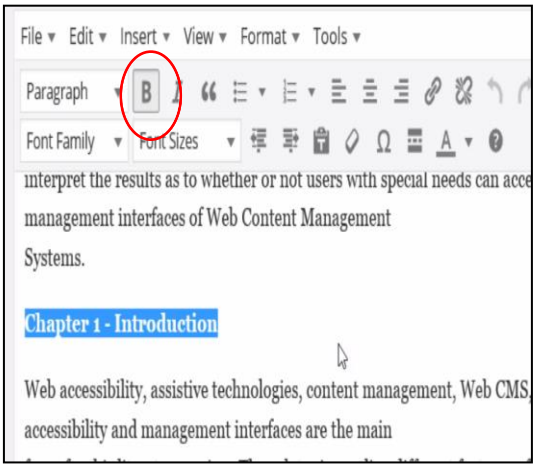


Figure 5.10c: Make text bold for headings

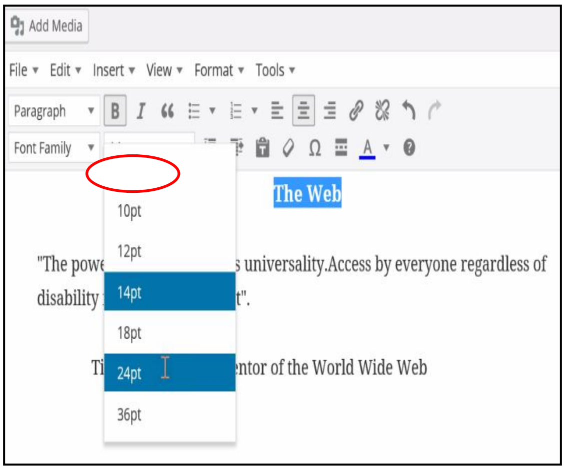


Figure 5.10d: Font size applied to the headings

Figure 5.10: Different ways used by participants to implement the headings

Since headings and subheadings are among the essential constituents of any document, including web documents, their presence and structure are critical for both humans and software to comprehend the underlying structure of a document and the relationships between the various content sections. For sighted readers, headings allow them to skim and scan the page to see its structural relationships and select the relevant information they are seeking. For users of screen readers, headings allow the assistive technology to isolate the structure and navigate between sections. When a web document is well structured through the hierarchical use of HTML tags (<h1> to <h6), page content is divided into significant sections with headings that provide a general outline of the document and allow quick information retrieval (webAIM, 2018e). In this research, participants in AUG failed to use these headings; instead, some participants applied fonts

and boldness only to change their appearance, which is inaccessible by screen readers and fails to meet various W3C success criteria, including 1.3.1 Info and Relationships (Level A), 2.4.1 Bypass Blocks (Level A), 2.4.6 Headings and Labels (Level AA) and 2.4.10 Section Headings (Level AAA). Previous studies have shown that the lack of headings is a common accessibility problem (Pribeanu, Fogarassy-Neszly, & Pătru, 2014) and that their presence improves usability (completion time and satisfaction with site structure) for both sighted and visually impaired users (Watanabe, 2009). Even if the system provides the possibilities of implementing heading elements, novice users (as shown by AUG participants), unless they are specifically trained, may fail to understand their contribution to improving accessibility.

5.2.2.2 Paragraphs

The paragraph function was the least implemented element by participants in both the AAG and AUG. As with the heading level elements, WordPress allows users to implement proper paragraph level structuring, although only in visual mode (using the default installation of WordPress). Apart from a small number of participants in the AAG who selectively applied the <p> tag, all other participants failed to implement it. Participant recordings showed that some of the participants either used the 'Enter' key to separate text blocks or simply copied and pasted the provided text, which showed the page content as non-structured text blocks (Figure 5.11a). The formatting convention for the paragraph requires the use of the HTML <p> and </p> tags, which serve to separate paragraphs rather than having to use multiple breaks (e.g. BR BR). This encloses blocks of text within their own structural elements and identifies them as being separate entities. Assistive technologies such as screen readers can jump from P to P but not from BR to BR (Pennsylvania State University, n.d. -a) and may also identify a block of text as a discrete paragraph (Figure 5.11b) so that users can navigate between paragraphs and skim the section's content.

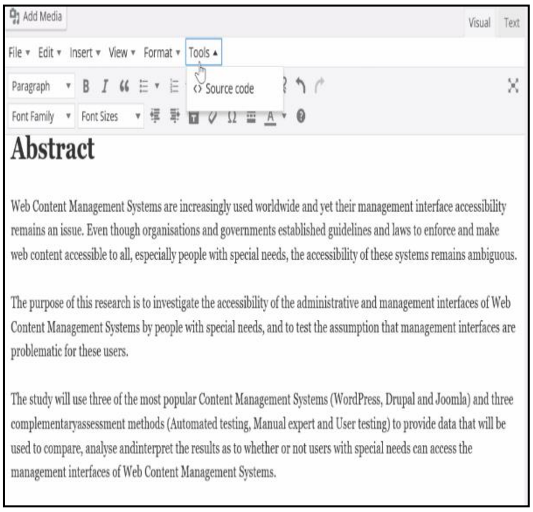


Figure 5.11a: Structured paragraph

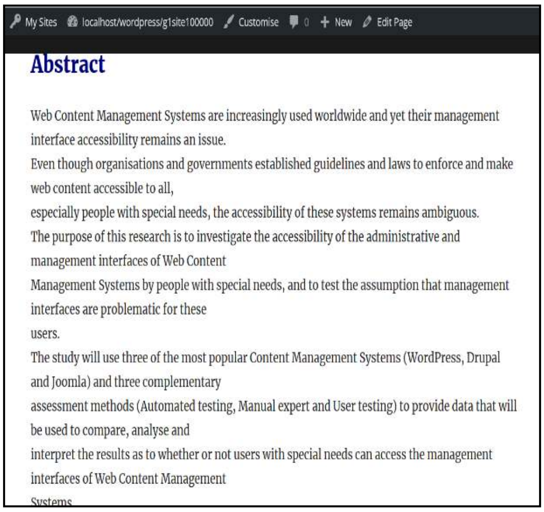


Figure 5.11b: Unstructured paragraph

Figure 5.11: The paragraph level structure used by the participants

In this study, most of the participants, mainly those from AUG, failed to implement the paragraph—they were interested in visually formatting the content but not in the application of correct structural elements. This inconsistent styling does not contribute to accessible content because 'the consistent styling of paragraphs improves text readability. It also gives users more control when customising their view'(W3C, 2017c).

5.2.2.3 Hyperlinks

Similar to headings, the WordPress default toolbar offers the possibility of creating hyperlinks in various ways through the visual or text modes (shown in Figure 5.12). Participants had two possibilities in each mode for inserting links: in the visual mode, they could use the Insert/Edit link (Figure 5.12a) or link icon in the toolbar (Figures 5.12b), and in the text mode, they could use the Insert/Edit link (Figure 5.12c) or HTML code (Figure 5.12d).

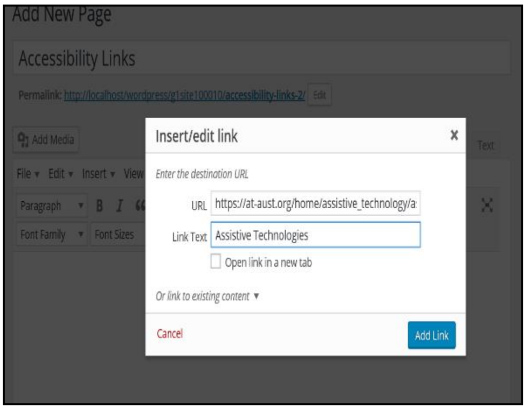


Figure 5.12a: Using Insert tab in visual mode

Figure 5.12b: Using Insert icon in visual mode

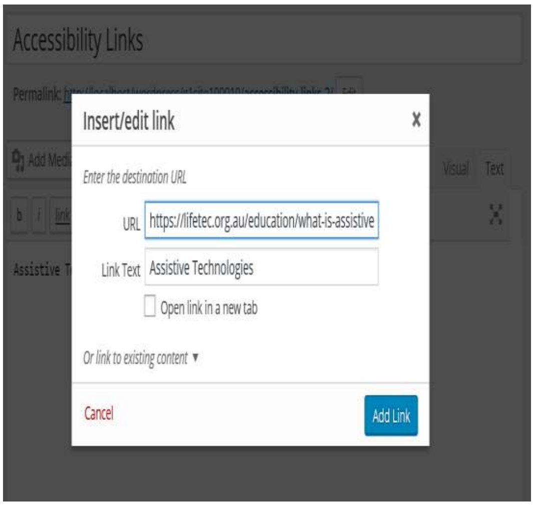


Figure 5.12c: Using Link tab in text mode

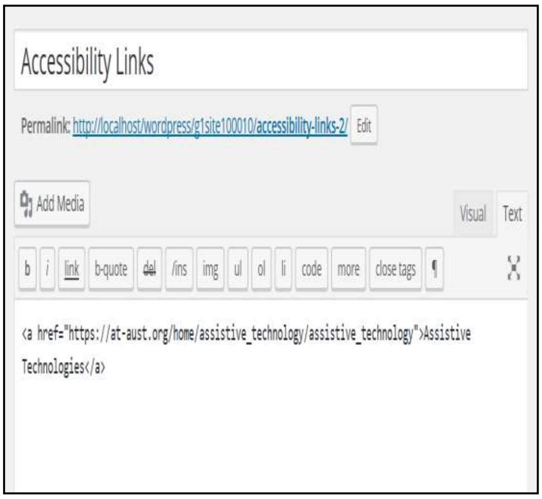
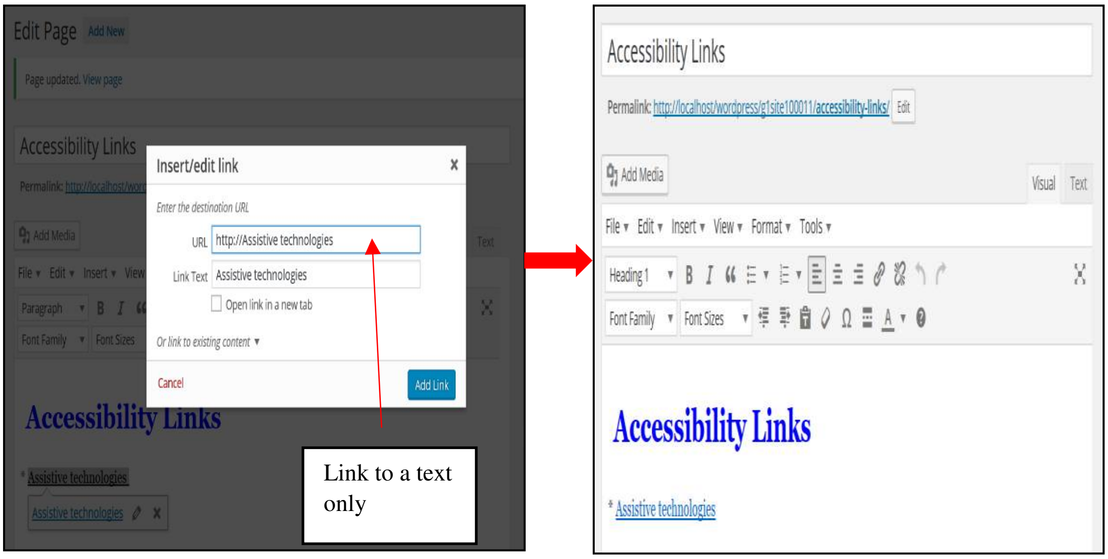


Figure 5.12d: Using HTML code in text mode

Figure 5.12: Different ways to insert hyperlinks

In both groups, three participants did not insert the hyperlinks, including one in each group who inserted a false link that appeared as a link but was linked to text only (shown in Figure 5.13). The remaining participants created the hyperlinks using both modes. Most of the participants in AAG (eight) used the toolbar link icon in text mode, while only one participant attempted to create the hyperlink using the HTML code but failed to create the link correctly. Most of the AUG participants (seven) inserted the link using the visual mode, while the remainder used the link icon in text mode.



Link using <a> (anchor tag) | Result: Linked only to text

Figure 5.13: False link created using HTML code in text mode

Inserting hyperlinks into the web page was the most straightforward task to undertake. Almost all participants in either AAG or AUG did not find it difficult; therefore, links were created in most of the pages. Hyperlinks are mainly used to ease navigation between web pages. To be accessible, hyperlinks should be the following:

- Clear: hyperlinks should have purpose and context for all users as stated by WCAG 2.0 Success Criterion 2.4.4 Link Purpose (In Context) (Level A) (W3C, 2016c).
- Readable: Hyperlinks should use common terms and language to ease navigation for all users, especially those needing assistive technologies (Bureau of Internet Accessibility, n.d.)
- Visually distinct: Hyperlinks should not rely on colour only (WCAG 1.4.1 Use of Colour) but use other means, such as underlines, to convey the information and to differentiate them (WebAIM, 2018d).
- Colour contrast compliant: To allow all users to access information, especially for those with low vision, low-contrast vision or colour vision deficiency, the use of a recommended colour contrast ratio of at least 4.5:1 for normal text and 3:1 for large text (14 points and more) is essential (WCAG Success Criterion 1.4.3 Contrast (Minimum)) (Bureau of Internet Accessibility, 2017).

- Keyboard accessible: Hyperlinks should be accessible from either the keyboard or keyboard alternatives (such as screen readers) (Bureau of Internet Accessibility, 2018).

For the content, all participants in both the AAG and the AUG copied and pasted the text provided by the researcher and linked the text to the retrieved websites. However, the recordings showed that, with few exceptions, participants quickly read the summary presented on the first page of their Google search and used the URL of the first site they encountered (which did not exceed five sites) to create their links, which was a simple way of finding the information they were seeking. This behaviour aligns with the information-searching behaviour of web searchers that 'follows the principle of least effort' (cited in J. R. Griffiths & Brophy, 2006, p. 2), and the 'bottom-up strategy' in which 'participants looked for a specific keyword provided in their instructions and then scrolled through the results until they found the desired information' (cited in J. R. Griffiths & Brophy, 2006, p. 4). This strategy was adopted by most of the participants in this research, who all used Google as the primary search engine. (J. Brophy & Bawden, 2005) refers to this as the 'Googling phenomenon' for primary information retrieval, the advantages of which, according to, include:

- a high proportion of relevant documents retrieved
- an ability to retrieve a fairly precise set of documents
- a high proportion of adequate or good quality results
- a high proportion of unique documents and no problems with accessibility. (p. 13)

Overall, the implementation of accessible hyperlinks was not a complicated task for almost all participants in both groups. Most participants attempted to provide accessible hyperlinks, while others, especially those in the AUG, were more interested in page aesthetics and mimicked the look of the provided page without considering accessibility.

5.2.3 Content Formatting

5.2.3.1 Fonts family and size

The TinyMCE Advanced plug-in installed in WordPress provided the default toolbar from which participants could add font size and colours to text in the visual mode (as shown in Figure 5.7) or HTML codes in the text mode (as shown in Figure 5.8).

Participants applied fonts to the page title and content in the form of text in the visual mode throughout the WordPress toolbar as follows:

- They added only font size to the title, text or both.
- They added only font family to the title, text or both.
- They added font family and font size to the title, text or both.
- They did not add fonts to the title or the text.

Apart from the ‘Home’ and ‘Contact us’ pages, all participants did not apply both font size and font family to the text. However, for the other pages, the participants applied fonts to the page titles, but with obvious differences in method of implementation between AAG and AUG participants. Similar to the headings and in contrast to AAG participants, all AUG participants failed to add the title to the ‘Accessibility video’, ‘Ask a question’ and ‘Contact us’ pages, and for the remaining pages, they attempted to apply fonts to titles separately from the text. A small number of AAG participants applied font sizes of 16, 18, 24 or 36 points (nine times for all 15 sites) to the page title (because most of them implemented headings in the page titles) and the font families Bold Antiqua and Arial Black (six times for all 15 sites). In contrast, AUG participants applied font sizes of 10, 12, 14, 18, 24 and 36 points (15 times for all 15 sites) and the font family Helvetica (only one time for 15 sites).

Font selection is a significant factor in website accessibility. Font is designed to improve the readability of a site’s content for all users, which is supported by the W3C guidelines for implementing fonts. In WCAG versions 2.0 and 2.1 (not covered in this research), W3C states four established principles encompassing 13 guidelines. Principles in the latest WCAG version are summarised by the Bureau of Internet Accessibility (n.d.)as follows:

- Perceivable:
    - Create content that can be presented in different ways without losing meaning.
    - Make it easier for users to see and hear content.
- Operable:
    - Give users enough time to read and use content.
- Understandable:
    - Make text readable and comprehensible.

        - Make content appear and operate in predictable ways.
- Robust:
    - Maximize compatibility with current and future user tools. (p. 1)

The implementation of these components should be accompanied by an adequate selection of font size and family. In this research, apart from the 'Contact us' page, participants in both groups only applied fonts to page titles, not page contents. Of the font families used, Arial Black was among the most common and is considered easy to read on the web (Bernard & Mills, 2000; WebAIM, 2018c). Given that there is no consensus or universal standards about the selection of an appropriate and readable font for web use, website developers are advised to use fonts that are readable and that avoid visual confusion (WebAIM, 2018c).

Similarly, participants applied different font sizes of between 10 and 36 points, especially those in AUG who used font size to separate page titles from page contents. Similar to font family, there is no standard or perfect font size recommended for web pages (WebAIM, 2018c). Fortunately, new technologies and browsers permit users to increase or decrease font size, unless text zooming reaches to 200% (W3C, 2016d). WCAG 2.0 Guideline 1.4.4: Resize Text states that 'Except for captions and images of text, text can be resized without assistive technology up to 200 percent without loss of content or functionality'(W3C, 2016d). This customisation generally makes font size less critical than it was previously.

It was interesting to discover in this research that all participants did not apply fonts to the content of pages, except for pages with coloured content such as the 'Contact us' page. All participants copied the provided content without attempting to apply fonts, despite these components having low complexity and being the easiest to implement.

5.2.3.2 Colours

Using the WordPress toolbar, participants applied font colours to website headings. Most of the participants in AAG applied vivid blue to most of the page titles, with black, dark lime green, red and cyan being applied in a small number of cases. In contrast, a small number of AUG participants applied vivid blue and navy blue, but the remainder did not apply colours to the headings. All participants in both AAG and AUG did not apply colour to the text—they simply copied and pasted the content provided to them without applying visual enhancements.

Colours of both headings and text were analysed using Colour Contrast Analyser 2.4, a WCAG 2.0-compatible tool that helps to 'determine the legibility of text and the contrast of visual elements, such as graphical controls and visual indicators' (The Paciello Group, n.d.). Results for headings with white background were as follows:

- Vivid blue passed Level A, AA and AAA for normal and large text (Figures 5.14 a) with a contrast ratio of 8.6:1.
- Dark lime green failed Level AAA for normal text and passed other levels for normal and large text (Figure 5.14b) with a contrast ratio of 5.0:1.
- Red passed Level AA for large text but failed for the other levels and normal text with a contrast ratio of 4.0:1.
- Cyan failed at all levels for both normal and large text (Figure 5.14d) with a contrast ratio of 1.9:1.
- Navy passed at all levels for normal and large text with a contrast ratio of 16.0:1 (Figure 5.14e).
- Black passed at all levels for normal and large text with a contrast ratio of 21.0:1 (Figure 5.14f).

Except for cyan, all other colours used by the participants for headings (which was limited to those in the AAG) were within the recommended W3C contrasts. Guideline 1.4.3: Contrast (Minimum) recommends a luminosity ratio of at least 4.5:1 for the main text and 3:1 for large-scale text (18 points+ or 14 points+ bold) for Level AA (W3C, 2016a). According to the Bureau of Internet Accessibility (2017):

> The 4.5:1 contrast ratio is intended to address the loss of contrast that users experience if they have low visual acuity, age-related loss of contrast sensitivity, or colour deficiencies. WCAG recommends a 7:1 contrast ratio for users with vision loss equating to 20/80 vision, but 3:1 for large text since large print with wider character strokes is much easier to read at low contrast. This gives site owners more colour choices for large text placement, such as in titles and headers. (para. 6)

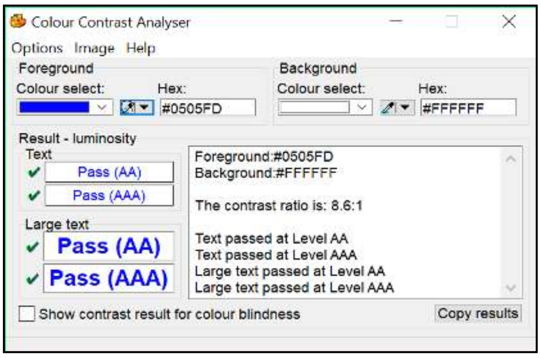


Figure 5.14a: Test for vivid blue

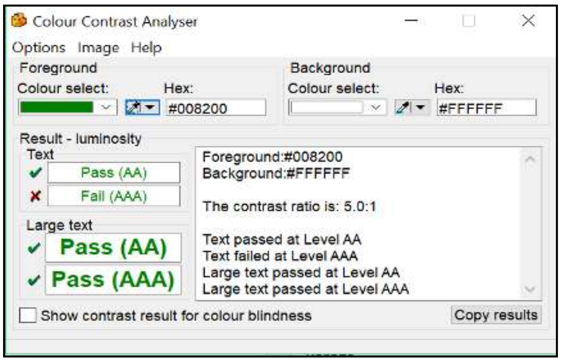


Figure 5.14b: Test for dark lime green

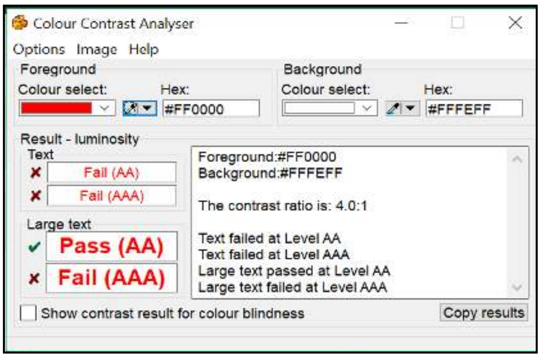


Figure 5.14c: Test for red

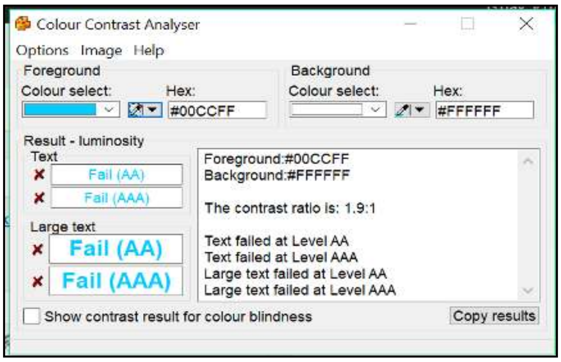


Figure 5.14d: Test for cyan

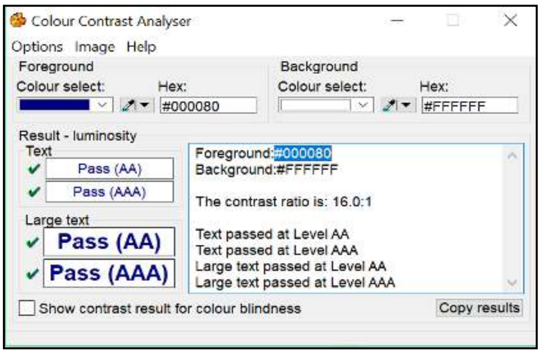


Figure 5.14e: Test for navy blue

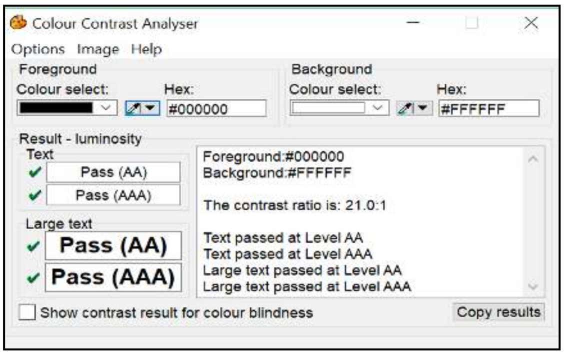


Figure 5.14f: Test for black

Figure 5.14: Analysis of colours used for headings with white background

Adequate contrast between the foreground (text or graphics) and the background is effective for any display. Typically, the combination of black and white creates a high contrast that may cause glare; therefore, using online testing tools to contrast colours appears to be a good solution for colour mixes (Pennsylvania State University, n.d. -b). In general, participants in AAG applied an effective colour combination to headings without the use of tools. In the case of AUG participants, who did not apply colours to the text, the default colour used in Notepad provides a contrast ratio of 21.0:1, which is sufficient to make content accessible by all users. Applying colours to headings or text was a simple task to complete, but it was an issue for most AUG participants in their page development. It is unclear if participants were mostly successful in effective application of colour contrast because of the accessibility guidelines or simply because they took a default approach to text presentation.

5.2.3.3 Bulleted lists

Participants in AAG and AUG could create a bulleted list using the WordPress toolbar in either the visual mode (Figure 5.15a) or the text mode (Figure 5.15b), using <ul> for unordered lists (in which the order of items is not essential) and <li> to list item elements. However, no participants created the required unordered list in any website. Only three AAG participants and one AUG participant created the required list. The only explanation for this behaviour is that the provided list was not entered as a bulleted list. Instead, searchers entered the hyphen-minus character in place of bullets, copying the content exactly as shown in the example output.

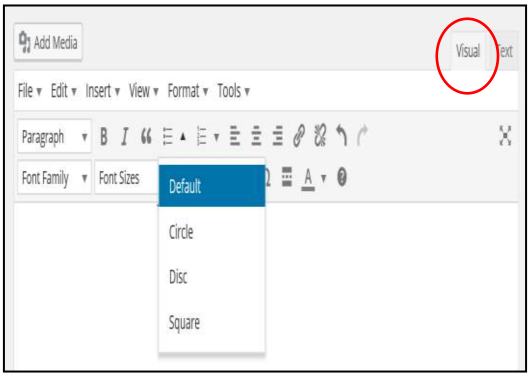


Figure 5.15a: Creation way in visual model

Figure 5.15b: Creation way in visual text mode

Figure 5.15: Bulleted list creation in visual and text modes

From an accessibility perspective, lists simplify and organise information in a hierarchical and well-structured manner, making the structure easily detectable and readable for users of screen readers. As well as using correct formatting of list elements, lists provides information about its beginning and components, which is one of the recommendations of WCAG 2.0 Success Criterion 1.3.1 Info and Relationships. This criterion states that 'Information, structure, and relationships conveyed through presentation can be programmatically determined or are available in text. (Level A)' (W3.0rg, 2016b).

Even if the structure appeared to be acceptable in developed websites, most participants in AAG and AUG did not create the bulleted list in the web CMS page, meaning that they failed the simple task of implementing accessible information for users of screen readers in the form of an appropriate semantic mark-up. It was difficult to discern the reason for this, especially when the system incorporated the necessary elements in its toolbar, however, once again, participants appeared to abide by the rule, ‘if it looks the same, it must be the same’.

5.2.4 Embedding Videos

WordPress offers various possibilities for embedding videos (as illustrated in Figure 5.15), which were used by participants in this study to insert the required videos on their websites. Recordings show that in both groups, participants inserted videos by:

- inserting code in text mode (Figure 5.16a)
- copying the video URL code into the editor in visual mode (Figure 5.16b)
- inserting the embed code (Figure 5.16c)
- using the ‘Insert’ tab on the visual toolbar (Figure 5.16d)
- using the ‘Add Media’ tab in visual mode (Figure 5.16e).

Unlike previous tasks, this task had less to do with ‘the how’ as it did with ‘the what’, being the correct selection of videos with closed captions. For the first video (Figure 5.17a), 10 participants in AAG inserted closed caption videos compared with three participants in AUG. The remaining of participants in both groups inserted uncaptioned videos (Figure 5.17b) or did not insert any. Similarly, for the second video (Figure 5.17b), nine participants in each group inserted the correct video, while six participants in AAG did not insert the video. Two participants in AUG inserted the video incorrectly and four participants omitted the video. Even though the participants were asked to look for closed caption videos and insert them into the ‘Accessibility video’ page, they tended to insert uncaptioned videos. This behaviour may be explained by the fact that in the provided output, one of the videos was an open caption video and participants looked for and inserted the same video. In other words, they simply mimicked the provided output without understanding or even noticing the difference between captioned and uncaptioned videos.

Figure 5.16a: Using code in text mode

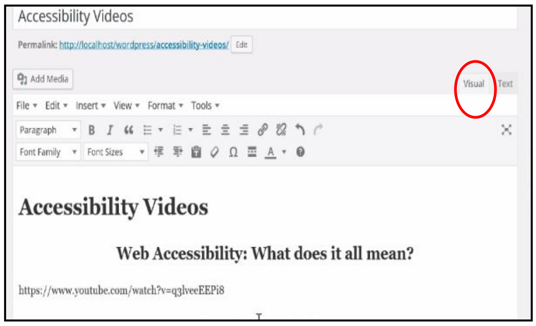


Figure 5.16b: Copying URL in visual mode

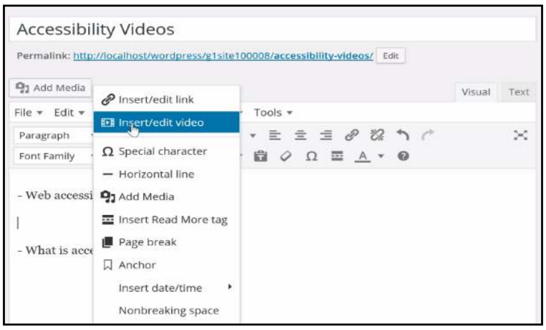


Figure 5.16c: Inserting embedded code

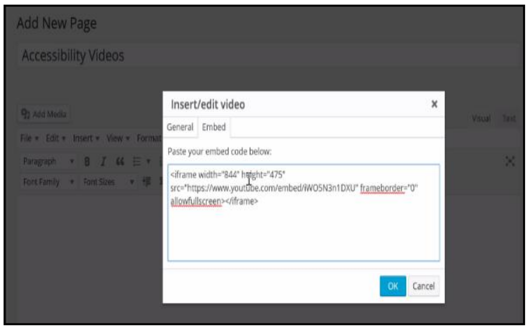


Figure 5.16d: Via 'Insert' tab in visual mode

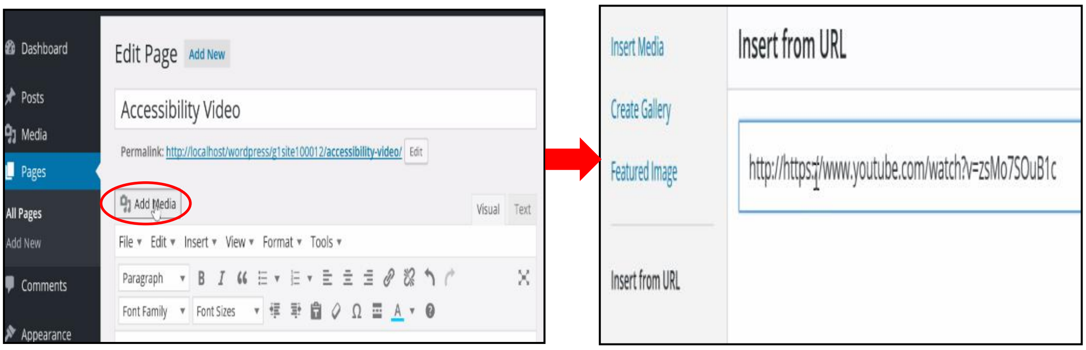


Figure 5.16e: Via 'Add Media' in visual mode

Figure 5.16: Different ways used by the participants to embed a video

Participants were required to include two closed caption videos that could be turned on or off by the user, a distinctive audio feature used by people with hearing impairments or in noisy environments (WebAIM, 2013a), those with cognitive and learning disabilities or those who do not speak the language spoken in the video (W3C, 2016g). AAG participants inserted more captioned videos (Figure 5.17a) than uncaptioned videos (Figure 5.17b). In the pre-task awareness session, participants were shown two videos, one captioned and one uncaptioned, so they could discriminate between them. In contrast, AUG participants inserted more captioned videos (the second video)—from the table, it appears that those participants were, once again, influenced by the example provided rather than by the desired accessibility outcome of the task.

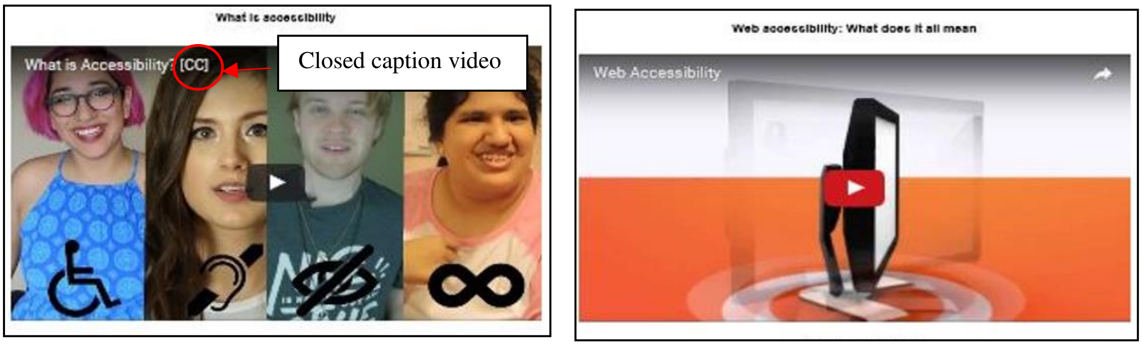


Figure 5.17a: Captioned video

Figure 6.17b: Non-captioned

Figure 5.17: The two types of videos presented in the exemplar output

Besides the type of videos, the process of searching and the methods of inserting them were other aspects considered in this research. For both groups, YouTube was the primary website used by almost all participants to find videos, with only a minimal number searching for required videos using the Google Videos option. Recordings show that, in most cases, participants from both groups first viewed the videos provided in the pre-task awareness sessions, then searched for those specific videos. Search strategies were simple and straightforward—no participants used complex queries to find the videos and all used the words provided in the titles of the videos (i.e. web accessibility). Nevertheless, some studies have shown that both simple and complex queries in the same search engine provides approximatively the same results (Jansen, 2000).

5.2.5 Adding Tables

Another task for participants was to add a table via the WordPress text editor. This task was perhaps the most challenging of all tasks presented to participants. Because the table plug-in was intentionally disabled in this research, participants were required to insert the table using a choice of either text mode or visual mode. Those who used the text mode created the table using HTML elements (Table 5.1), allowing them to provide an accessible table. WebAIM (2018b) offers the following explanation about the purpose and use of accessible tables:

> The purpose of data tables is to present tabular information in a grid, or matrix, and to have column or rows that show the meaning of the information in the grid. Sighted users can visually scan a table. They can quickly make visual associations between data in the table and their appropriate row and/or column headers. Someone that cannot see the table cannot make these visual associations, so proper Markup must be used to make a programmatic association between elements within the table. When the proper HTML Markup is in place, users of screen readers can navigate through data tables one cell at a time, and they will hear the column and row headers spoken to them. (para. 1)

Table 5.1: Basic elements for building an HTML table

HTML Element	Function
<Table>	Defines a table
<caption>	Defines a table caption
<th>	Defines the table header
<tr>	Defines the table row
<td>	Defines the table data/cell

Participants attempted to build the table in a number of different ways:

- Copying the content as it was without any effort to correctly format it
- Copying the content and unsuccessfully attempting to create the table by looking for codes in various websites
- Copying the content as well as codes from other sources and successfully adjusting codes to the table.

Those who attempted the task used the text mode to insert the necessary HTML elements (Table 5.1) were successful in building an accessible table. Tables are structured using header cells and data cells that define their relationships, providing information for users (W3C, 2017a). A well-structured table allows a screen reader to move correctly across cells from left to right and to correctly read the content to the user. In this research, a significant number of AAG participants (66.7 %) (see Table 4.33) made a 'good' effort by successfully adapting copied codes from different sources to the table, while most AUG participants (86.7%) did not attempt to build the table, thus failing to provide accessible table.

As previously seen, participants in this research, specifically those in AAG, were unfamiliar with HTML coding, accessibility concepts or even the CMS itself. In a short period, using different methods, they learned some concepts, provided outcomes and attempted to overcome the problems they confronted while performing tasks or implementing the necessary components.

5.3 Participant Behaviour

This section analyses the behaviours that assisted participants to accomplish tasks. When undertaking tasks and applying components, participants in each group used different techniques to find the necessary information and spending time and effort, which influenced whether tasks were completed. This section focuses on these three elements, which highlight participant behaviours.

5.3.1 Search Procedure

Participants in both groups searched for information from online sources and services about HTML codes or potential means of performing tasks. They used four searching techniques (shown in Figure 5.18), which aligned closely with those identified by Kinley, Tjondronegoro, Partridge, and Edwards (2014):

- Information-searching strategies, based on how a user performs information searching
- Query reformulation behaviour, based on how users formulate and reformulate their queries during web searching
- Web navigation styles, based on how users navigate during web searching
- Information processing approaches, based on how they view and process search results or retrieved result pages. (pp. 1114-1115)

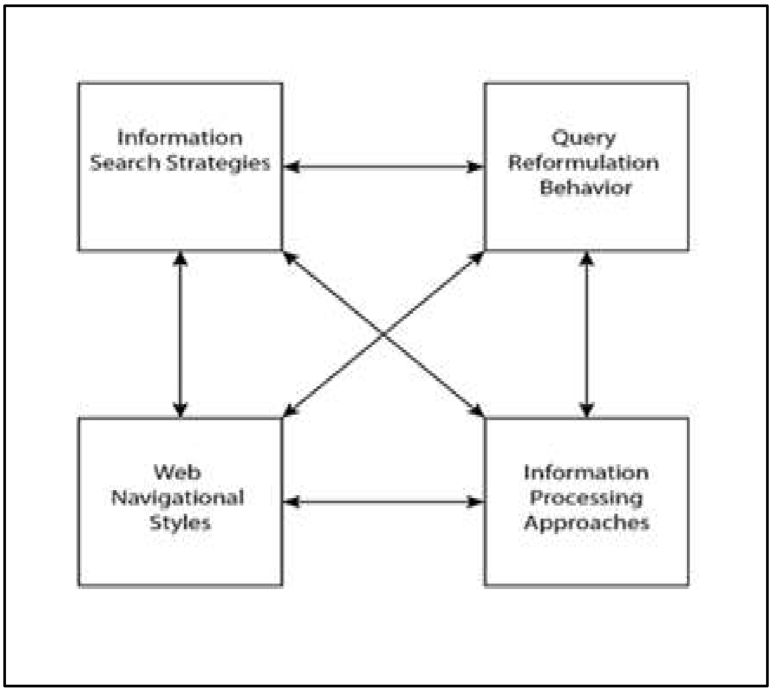


Figure 5.18: Aspects of web search behaviour(Kinley et al., 2014, p. 8)

Indeed, participants in this study used similar aspects in their searching activities, varying and combining these strategies to retrieve the necessary information. During their searches, some participants in AAG used general terms such as ‘HTML code for the table’ or shifted to more refined and clear terms, while others reformulated their queries by adding terms such as ‘HTML code to create an accessible table’ (Participant 100000) (see Table 4.29). Alternatively, other participants used web navigational styles to locate information—some randomly selected sites, while others followed proposed links to find the relevant information. Recordings of the time spent on each site show how participants approached the information—spending more time on a page appeared to indicate that the participant was reading rather than simply scanning retrieved content.

Most participants across both groups used the ‘use terms to locate information’ technique to locating content relevant to the tasks they were attempting. However, AAG participants used this technique slightly more frequently than those in the AUG. Unsurprisingly, participants in both groups typically used Google as the principal search engine, then followed links to the sites they thought would be useful. AAG participants used W3Schools as the primary reference for HTML code, while the number of times AUG participants visited the site was negligible.

5.3.2 Time Spent on Tasks and Online Searching

Participants in this study spent time performing tasks and searching for information about codes, how to implement components or about some of the required materials (e.g. videos). The video recordings show variability in time spent completing tasks between AAG and AUG participants as well as within each group. AAG participants allocated more time to the 'Web CMS' page, followed by the 'Home' page and then the 'Ask Question' page. Some spent half of the allocated time developing the 'Web CMS' page because of the page content (e.g. links and table), while others spent less time. Similarly, AUG participants assigned more time to the same pages, but less time than AAG participants spent because they were focusing on page appearance rather than on accessibility. Differences in time within and between groups, evidenced by a significant 95% CI, may be explained by:

- the effort that participants made to perform tasks successfully
- searching methods used to find accurate information
- task difficulties prompting online research
- previous skills and knowledge that helped them to complete the tasks.

These elements may have influenced the time spent on each task and page as illustrated in Figure 5.19. The website had six pages, but relevant findings came from the four pages shown in Figure 5.19. In general, participants in both groups applied most effort for the two first pages in structuring, formatting and applying accessible components, and less effort for the remaining pages. Given that participants spent two hours developing a website and implementing accessible components using an unfamiliar tool, this may have resulted from participant fatigue.

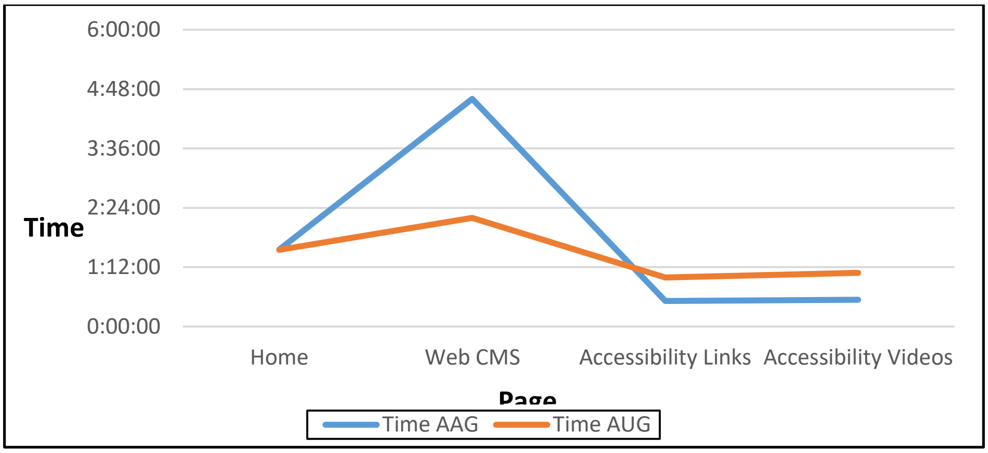


Figure 5.19: Time spent on tasks by group

Moreover, the difference between the two groups in terms of searching time was apparent. AAG participants spent more time online than did AUG participants, which was associated with a noteworthy outcome—AAG participants searched for information mostly in Google and W3Schools, which may explain their attempts to find accessible codes and their perseverance in implementing accessible components in their websites. In contrast, AUG participants spent only one minute in total in the W3Schools site and most of their time searching in Google and other irrelevant sites.

Those participants who performed accurate web searches and appeared to read the resulting web pages before applying what they had learned were more effective in task performance than those who looked at less relevant sources and only seemed to skim content. Figure 5.19 indicates that AAG participants who spent a significant amount of time on the first accessibility task tended to spend even less time on subsequent tasks than did the AUG participants, who demonstrated a consistently low time commitment across all tasks. Given that the literature shows that time and effort spent on searching contributes to the quality of information retrieval (Al-Maskari & Sanderson, 2010; C. Liu, Liu, & Yan, 2018; Luo et al., 2017), this finding is not surprising.

5.3.3 Influence of Effort on Task Completion

Participants' achievement in required tasks relied partly on the efforts they made. Identified efforts varied from task to task and from group to group. Participants in AAG made a better effort than those in AUG for the most common components. For instance, when inserting alt text for images, most of the AAG participants made a basic effort to provide accessible outputs. In contrast, except for the 'basic effort' made to implement components for videos, a significantly higher number of AUG participants made no effort to accomplish the specific required tasks. As shown in Table 4.33 and by the recordings, these participants focused only on copying and pasting the provided content.

It was evident that for each task completed, accessibility was affected by the participant's effort. Tasks for which participants had more focus, such as tables and images, were developed with HTML elements, which contributed to their accessibility. Because the AAG was informed about the tools, materials and concepts for achieving accessible outcomes, this awareness helped in achieving tasks driven by the accessibility concepts they had been shown. Thus, the degree of effort made by participants influenced the outcomes. This finding aligns with a study by Hoegl and Gemuenden (2001), which found that the effort applied to tasks affects a project's success (p. 440).

Participants' behaviour in task performance were difference between the AAG and the AUG. Searching strategies, time spent and efforts made were different between groups, influencing the outcomes. This supports the finding that awareness plays an essential role in developing competency in accessibility requirements.

5.4 Impact of Awareness

The awareness session provided an abridged overview of accessibility concepts and standards to each group and additional HTML information for AAG. In the session, all participants learned new concepts, developed new skills and provided outcomes that reflected their improvement and benefits from the session. This section focuses on these aspects and analyses the output provided by both groups at the end of the awareness session.

5.4.1 Outcomes Derived from the Session

Outcomes regarding components implemented, tasks completed and sites developed were different for each group. As discussed in Section 4.3.1, AAG participants implemented more components and used WordPress formatting to create accessible content. Although their use of HTML elements was minimal, some AAG participants developed their websites using accessible HTML, while none of the AUG participants implemented code (as shown in Table 4.21). This is associated with the learning process, which emphasised the role of HTML and the effectiveness of participants searching through web resources for satisfactory solutions to help in completing their tasks.

Results showed that participants in AAG completed more tasks than those in AUG. Task completion was related to a number of elements, including participants' prior skills and experience in using the web, motivation to provide accessible content, participation in the awareness training session and learning abilities. Even with a limited or lack of previous knowledge regarding HTML, accessibility and guidelines, the participants developed websites with some level of success. This achievement was observed in the application of codes and formatting in the correct and desirable way, as illustrated in Figure 5.11a, which shows the impact of the awareness training session on the outcome.

During the awareness training session, the participants in AAG learned about accessibility concepts and were guided in implementing HTML codes. The screenshots in Figure 5.20 provide examples of typical screen captures that show how awareness was beneficial, increasing participants' concern about accessibility and their desire to improve accessibility for the benefit of all web users.

Figure 5.20a: Screenshot of image attributes

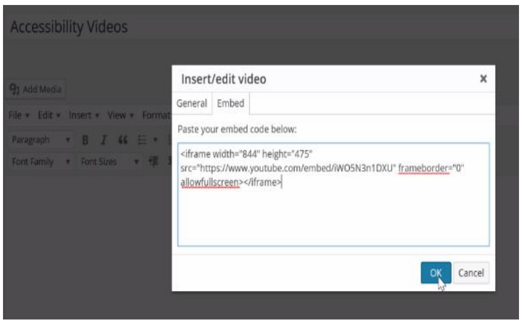


Figure 5.20b: Screenshot of video

Table 4.1: Plugin manipulation per system per error types

	WordPress		Joomla		Drupal	
	Add Plugin	Delete Plugin	Add Plugin	Delete Plugin	Add Plugin	Delete Plugin
AA: 1.4.3,AAA: 1.4.6 – Colour Problem	39	43	213	27	37	38
AA: 1.4.4 – Text Size Problem	93	45	498	201	4	5
AAA: 1.4.6 – Colour Problem	64	40	34	0	19	14

Figure 5.20c: Screenshot of the table

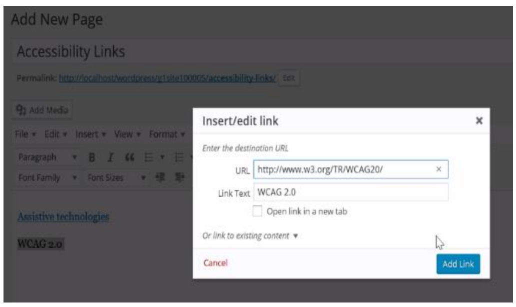


Figure 5.20d. Screenshot of link

Figure 5.20: Screenshots of some outcomes after the awareness session

5.4.2 Progress Perceived

All participants came to this research with different levels of prior skills and knowledge. The pre- and post-tests showed the prior knowledge of participants and their improvement regarding accessibility and its environment (codes, concepts, guidelines and web CMSs).

The increase in the average number of correct responses from the pre-test to the post-test showed that AAG participants performed better than AUG participants. Improvements were observed mostly in the AAG and the gap between two groups was evident. The paired *t*-test showed that the differences were significant and results supported the hypothesis regarding differences in participants' HTML and accessibility knowledge before and after the awareness session.

Further, the participants recognised the changes in their skills, confirming that the awareness materials had improved their accessibility knowledge. Most of the AAG participants declared that the session was useful for their learning and agreed on the clarity, simplicity and the usefulness of the material provided. AUG participants were also positive about the session and its content; however, some suggested that documents could be written more clearly and instructions made simpler.

Although the materials were succinct, participants had higher expectations, as observed in their suggestions. For instance, the user manual (see Appendix A) was precise and gave all the steps for developing each page in WordPress; however, some participants stated they had difficulty understanding and following instructions because this was their first experience with the system and with accessibility concepts. Despite this, all participants developed the required six web pages to build the website in the allocated time of two hours, showing evidence for progress of participants as a result of the awareness session.

5.4.3 Awareness Session Benefits

The awareness session incorporated various aspects related to accessibility, web CMSs and HTML codes (see Figure 5.1). Background information of participants showed that a significant number had been unfamiliar with these concepts. Nevertheless, during the session, all participants from both groups increased their knowledge and understanding of accessibility.

Differences between the pre-test to the post-test results showed that participants improved their skills in accessibility and HTML codes. In a short period, they learned about the W3C and its mission and guidelines (WCAG and ATAG) as well as some useful elements about accessibility. They also benefited from understanding how to use HTML codes to make websites more accessible for all users, especially those with special needs. Given that participants expressed their willingness to consider web accessibility in the future, the awareness training appears to have been worthwhile.

Another benefit of awareness training for participants was how to work with a web CMS. Prior to the awareness session, a significant number of participants had never heard of web CMSs or did not know how to use them. After trialling WordPress, most participants cited its benefits, particularly its numerous features and functions, and supported its use and recommendation. Given the positive nature of the feedback, it appears that the awareness session was useful for participants with respect to understanding how to work with a web CMS.

This section analysed three crucial aspects of the awareness that emerged from this research. The participants in the awareness group were more aware of and responsive to accessibility concepts, which they attempted to implement. Significant changes were seen in the development process—participants learned new concepts, as seen in their responses before and after the session, and improved their skills, reflected in the development of their websites. The benefits of the awareness session included communication of information, empowerment of individuals, improved skills regarding systems and web language and enhanced accessibility.

5.5 Chapter Summary

This chapter revealed the relative differences in the way participants from each group tackled the various tasks and in their accessibility outcomes. It is apparent that those participants who participated in the awareness training session conducted some degree of web research to complete tasks in a way that would be accessible, while the non-awareness group did not. Participants in the awareness group spent more time on the earlier tasks and accessibility requirements but tended to rush through later tasks with little or no focus on accessibility. Participants in the non-awareness group had a less consistent approach to tasks and little focus on accessibility from the outset.

Post-test results showed that AAG participants had greater improvements in their learning than did those in the AUG. AAG participants increased their knowledge about the accessibility environment, going from being accessibility illiterate to gaining some skills during the awareness session. AUG participants did not show improved skills because the accessibility concept alone is not sufficient to achieve implementation of accessibility components or to meet its aims.

This chapter also analysed task complexity and the differences in efforts made. AAG participants made the effort to search for solutions to accomplish difficult tasks that met accessibility requirements, while AUG participants failed to complete the most challenging tasks (e.g. the table). The time allocated for tasks and the research strategies adopted by AAG participants to locate information or HTML codes because of the task difficulties helped them to complete tasks in a way that made them accessible. However, task complexity did not appear to motivate the same effort for AUG participants, who proceeded to copy and paste the provided content or mimic the outcomes.

Participant knowledge was a noteworthy aspect arising from this research. There was a diversity of prior skills and experience, which reflected participants' behaviours towards searching, adapting, implementing and achieving the tasks. This aspect allowed the categorisation of participants into two sets: those (mostly from AAG) who 'knew' and could apply tasks in a straightforward manner, and those (mostly from AUG) who 'didn't know' and either attempted and achieved tasks, attempted and failed them or failed to attempt them at all, with the latter mostly applying to the most challenging task (the table).

The awareness training session was beneficial to participants—in a short period, there was an apparent change in their knowledge, particularly for those in AAG. Following the awareness session, participants, whose experience and skills were limited or absent before the session, showed significant improvement in their knowledge about accessibility, guidelines, HTML and web CMSs. The session revealed knowledge gaps and enhanced awareness about accessibility for participants, who are likely to consider it in their future work.

The use of WordPress helped participants build a website with some accessibility features. The WYSIWYG editor along with the toolbar, which was similar to that in Word, assisted participants, specifically those in the awareness group, in formatting and structuring websites and applying some HTML elements. These participants built the website with accessibility in mind, leading to accessible outcomes when used efficiently and adequately. However, because nearly all participants were unfamiliar with WordPress and had little or no knowledge about mark-up language, they encountered difficulties using all the options offered by the system, especially participants in AUG, who made little or no use of the text editor. Although the system included most of the components needed for this research, creating accessible components is an issue when users lack awareness, knowledge and experience.

The implications of these findings for participant knowledge, task completion and complexity and system usage will be discussed in the next chapter. The research contribution, limitations and recommendations for further research will also be presented, along with concluding remarks.

CHAPTER 6: DISCUSSION AND CONCLUSION

The current study was undertaken to determine the effect of accessibility awareness along with the use of an accessible web CMS on novice user outcomes. The principal focus is expressed in the main research question: ‘Can the use of a web CMS containing accessibility features lead to accessible outcomes by novices?’ This chapter will present the principal findings of the research in the context of the research’s supporting questions, followed by a final statement regarding the main research question. The chapter concludes with the limitations of the study, recommendations for further research and concluding remarks related to the entire study.

6.1 Impact of Accessibility Awareness

6.1.1 Supporting Research Question 1

What role does accessibility awareness play in the successful completion of tasks related to creating accessible web page content?

The findings of this research show that accessibility awareness plays a significant role in the successful completion of required tasks. Comparison of results from the two groups in the study showed an identifiable improvement in knowledge and better task completion for the awareness group. This conclusion is supported by differences between the pre- and post-tests, which show improvement in skills, the results of the web-based survey, which show changes in participants’ attitudes towards accessibility, and the number of successful tasks completed, showing participants’ determination to implement accessible components in website development.

The improvement in skills following the awareness session was noticeable. As discussed in Chapter 4, AAG participants showed a greater improvement in knowledge than did AUG participants. Pre-test results indicated that participants in both groups had little knowledge about accessibility concepts and limited skills in basic HTML coding and were unfamiliar with web CMSs. However, as seen in Chapter 4, there were some substantial differences in knowledge between AAG and AUG participants in some areas; therefore, it is essential to bear in mind that there was some possible bias. The gap between both groups was evident at the end of the awareness session.

During the awareness session, all participants were exposed to the same information (see Figure 5.2). However, the AAG group received supplementary training on HTML codes, which were focused mainly on components specific to this research, as well as a detailed video presentation to which they could refer for clarification. When completing tasks, recordings showed that the participants in AAG were more aware of developing accessible websites—they attempted to implement accessible HTML codes, used the WordPress text editor and formatting features and followed effective practices in searching for information to achieve accessibility.

Positive changes in responses from the pre- to the post-tests show that AAG participants developed more effective skills than did AUG participants (see Table 4.35). Improvements were confirmed by the paired *t*-test, which indicated significant improvement in the AAG participants' HTML and accessibility knowledge following the awareness session. In their self-evaluation, most participants in AAG reported that the awareness session materials improved their knowledge of accessibility. This suggests that accessibility is still an unknown field for diverse sectors of the community (as participants in this study came from four different educational disciplines) and that awareness training may be pivotal for disseminating knowledge about accessibility.

Possible explanations for the improvement in skills may include the content of the awareness session, the participants' willingness to learn and improve and the short period between the pre-test and site development. However, even in this brief period, the positive change in skills is promising. The increased knowledge may have been a result of the awareness session, which aligns with the findings of (Awatagiri et al., 2019), who found that training session strengthens and improves the knowledge of the participants to a study on good clinical practice.

Participant attitudes towards accessibility also influenced their tendency to implement accessible content. Initially, participants in both groups were unfamiliar with accessibility, with some participants having limited or no knowledge about it, despite their long experience of internet use. Through the process of learning and development, participants' awareness of accessibility improved. Results showed that more AAG participants expressed positive attitudes towards accessibility compared with AUG participants. Their positive contributions were evident in the implementation of accessible HTML codes, effective web CMS formatting (including fonts, text size, colours and resizing) and number of tasks successfully completed (163 for AAG, compared with 88 for AUG, as shown in Table 4.22). Additionally, awareness of accessibility changed from being almost non-existent to that of a primary concern for participants. Enhancement of participants' accessibility awareness may provide them with the necessary skills to ensure inclusiveness of all web users.

Participants in AAG were responsive to developing an accessible website with the presence of accessible components. Their determination to include these components was apparent in their search strategies and the time they dedicated to finding accessible HTML codes and other necessary information. Compared with AUG, participants in AAG were more aware of not only completing their tasks but about implementing the components to assure their success in task completion and make the content available and accessible to all users. The latter points to the focal aim of accessibility found in the literature and discussed in Chapter 2, supporting universal thoughts regarding access (Brajnik, 2011; Grantham et al., 2012; Henry et al., 2014; Hull, 2004; W3C, 2005; Yesilada et al., 2012).

Further, the noticeable determination of participants to apply the concepts learned was another positive outcome of the influence of the awareness session on task completion. Participants in the awareness group applied the new concepts they had learned during the awareness session, implementing more than half (52.5%) of the total components required across the 15 sites, compared with less than one-fifth (18.4%) for AUG participants. They also benefited from WordPress formatting and HTML codes in implementing the required components in website development. Although the AAG participants initially had a lower level of knowledge than AUG participants about accessibility and HTML, their outcomes were significantly better.

The correct application of tasks and accessibility components learned in the awareness session led to significant outcomes regarding accessibility. Most AAG participants accurately performed tasks and implemented the required components in during website development. This accuracy was observed in the efforts they made to search for information and adapt to achieve the desired outcomes (e.g. copying and adjusted codes for the table). By doing this, they were able to successfully complete tasks that, depending on the web page, contained some or all of the necessary components (Table 4.19). The number of tasks partially and entirely completed, compared with the completion rate of AUG, was a surprising result. Participants who previously had little insight into accessibility or WordPress and for whom the language of the web was an unexplored field realised outstanding outcomes within a short period. The results showing that most participants in AAG attempted to implement accessibility features in the sites they developed after a short awareness session are promising for the role of awareness in enlightening people about accessibility.

The improvements observed in attitudes, knowledge and task completion as a result of the awareness session are encouraging. These positive findings concur with those of previous educational and medical research. For example, a study by Arora et al. (2012) on the effects of safety awareness on surgical skills found that a short safety training session enhanced surgeons' skills and attitudes towards safety:

> Our training resulted in significant improvements in knowledge of safety principles and awareness of safety issues in the participants' own work environments. This highlights that surgeons were able to translate the training received in the half-day to a real practical understanding of patient safety problems in their own clinical workplace—a key aim of our program. Coupled with the fact that participants' attitudes about their ability to analyse errors, identify contributory factors, and improve safety significantly increased, it is possible that this training could act as a springboard for driving the development of interventions to enhance safety in surgical settings, championed by clinicians on the front-line. (p. 3)

6.2 Effect of Web CMS Usage

6.2.1 Supporting Research Question 2

What role did the usage behaviour of the web CMS environment play in participant's accessibility outcomes?

The outcomes of this research indicate that the correct and appropriate use of the system's environment partially influenced accessibility outcomes of the participant's task completion. It appears that two elements were crucial in contributing to these relatively positive findings: WordPress's integrated tools and participants' adequate use of them when developing their websites.

As discussed in Section 3.2.2., when WordPress (Version 4.5.2) was selected for this study, it incorporated nearly all the necessary components to allow participants to complete the required tasks to meet accessibility requirements. WordPress is designed to allow non-technical users to publish content on the web, and participants did not appear to have any particular issues using it. Even though WordPress has sufficient features to allow accessible content to be published, participants needed to be taught how to use these features correctly. Overall, only those with some level of accessibility awareness attempted to use features correctly, while the remainder used WordPress as a copy and paste tool. In other words, utilisation of WordPress depended on user knowledge of accessibility.

Another prominent characteristic of WordPress is that it has features that remind users to complete all fields appropriately. These useful features gave participants in this research the opportunity to add not only the alt text attributes but all those necessary for images (e.g. titles, captions and descriptions). The alternative text field in the image uploader (as shown in Figures 5.4a and 5.4b) allowed participants, particularly those in AAG, to add alt text and descriptions to images without coding (which AUG participants failed to do in most cases), ensuring compliance with WCAG 2.0 Guideline 1.1.

WordPress's default toolbar is another trait that allows users to structure and format accessible content using HTML code in either the text or visual editor. Participants in both groups used the toolbar to enhance website content; however, compared with AUG participants, AAG participants considered accessibility when developing their websites, used more effective strategies to assist with website development, made more effort and implemented a higher number of components. Their usage behaviour of the system's environment reflects the results delivered following the awareness session.

Participants' usage behaviours, focus and effort concerning the use of WordPress and the implementation of its components differed between the two groups. Differences in usage behaviours can be broken down into the following four categories:

- Point and click usage (themes, plug-ins and common toolbar elements for content structure and formatting): This category refers to the behaviour of 'doing what is obvious'. Participants in both groups used the most straightforward method, as explained in the user manual (see Appendix A), of adding required tools and features when they existed in the toolbar and were similar to Microsoft applications. Implementation of toolbar elements differed between groups (see Figure 5.3a)—even when the toolbar was similar to that of Microsoft Word, participants in AUG, compared with those in AAG, rarely used it to structure or format added content. This behaviour may be explained by participants' reluctance to apply these elements, their lack of awareness about the effects on outcomes or other factors such as time, lack of interest or perception of web CMS problems.

- Basic accessibility usage: The second category refers to the behaviour of 'doing what is known'. Participants in both AAG and AUG mostly used the visual editor rather than the text mode to insert elements via the system's default toolbar. As revealed in Chapters 4 and 5, participants in AAG performed better than those in AUG in website development. Even though the concept of accessibility was new for almost all AAG participants, they mostly used the system's default toolbar to add colours, links, font and insertion of videos in a way that ensured accessibility of content.
- WYSIWYG usage: This category describes the behaviours of AUG participants who were unaware of the aim of each component but only considered the appearance of the output (e.g. using a false link or only bold font or different font size to differentiate between headings and subheadings). In order words, as long as the end product looked like the example or source document, they considered the task complete.
- Accessibility aware usage: The final category describes the AAG participants' 'attempts to make an effort' to provide some level of accessibility to the content using HTML code in the text mode. Their attempts were apparent in their efforts to search online for accessible HTML elements for the table, videos or links and their determination to apply these elements in a satisfactory way. Their determination was apparent in their searching strategies, especially for the table codes, which were copied and adapted to their needs, the time they spent in completing this task and the efforts they made to deliver an accessible output. Compared with AUG, participants in AAG were aware of the importance of accessibility in their website development and the benefit of considering a wider community of users. Their combined behavioural attributes of applying knowledge, concepts, effort and time to the system's environment allowed them

to complete their tasks successfully and achieve a level of accessibility, which was reflected in their outcomes.

This categorisation indicates that participant behaviour is crucial in the understanding of system use, tasks performed and outcomes. However, behavioural factors remain elusive because this research did not use methods to evaluate participant behaviour; rather, the classification of behaviours was based on records of time spent, search strategies, attempts made and system tools used. Additionally, there is a little research in the core literature on the effect of usage behaviours of web CMSs on accessibility outcomes. Shroff, Deneen, and Ng (2011) focused on system usage and intention of use determined by perceived usefulness and perceived ease of use, which determined developers' behaviours and intentions (Shroff et al., 2011). Other research (S. Y. Park, 2009) has focused on the acceptance of e-learning systems, finding that 'both e-learning self-efficacy and subjective norm play an important role in affecting attitudes towards e-learning and behavioural intention to use e-learning' (p. 158).

To a certain degree, these claims apply to this research. The participants in both groups expressed their willingness to use WordPress in their future work. They also found that the system was user-friendly because it included all necessary features for building structured websites with accessible content.

Participant behaviour, especially for those in AAG, in using the system's environment, may have led to beneficial outcomes. When the system encompasses accessibility and the site developer is skilled, determined, motivated and aware of the importance of accessibility and its role, purpose and concepts, output should be accessible.

The principal finding is that raising an individual's awareness of accessibility principles may, in turn, influence him or her to use web authoring tools such as WordPress in a way that ensures accessibility. Reduced accessibility may be less determined by the web authoring tool than by the amount of time an individual is willing to invest in solving accessibility problems.

6.3 Role of Task Complexity

6.3.1 Supporting Research Question 3

What role does task complexity play in participants' behaviour and task completion in relation to the production of accessible content?

The response to this question involves three determining factors that played an essential role in participants' behaviour and the completion of complex tasks: searching strategies, time allocated to the task and effort made.

Results show that participants had difficulty completing some required tasks. Task complexity was determined by participant behaviours when developing the websites and by the final output. The differences between AAG and AUG were notable in that AAG participants attempted and completed a higher number of tasks and achieved better results in most tasks. AAG participants ranked the table as the most challenging task, which necessitated more time to search for and adapt HTML codes and finalise the task using the WordPress text editor. As the participants were unskilled in mark-up language and had no previous knowledge in accessibility, it was necessary for them to seek information from the internet in order to accomplish complex tasks.

Searching the web for information was the easiest and only way for participants to find what they needed for their tasks. Apart from the training videos provided to AAG participants, no other sources of information were provided. Nevertheless, the internet was the first option used to solve this problem, a common behaviour for all internet users. Some researchers have attempted to establish reasons for internet use. Dutta and Dass (2017) consider the internet as a primary source of information, while Connaway, Dickey, and Radford (2011) report that 'convenience [is] a major theme in different information-seeking behaviors' (p. 4) and that 'aspects of convenience include familiarity with a resource, perceived ease of use, and physical proximity' (p. 5). In their report on the use of libraries, museums and the internet, Griffins and King (2008, as cited in Connaway et al., 2011) state that, for adult users:

> The internet is not always chosen because it is considered the best source (74% of occurrences), but is nearly always chosen because it is convenient or easy to use (93%)

> and to a lesser degree is chosen because it does not cost much in time or money (69%). (p. 5)

Use of the internet as a major convenient and easy source of information is relevant to this research as the participants required the quickest and easiest way to locate information to complete complex tasks. When using the web, participants used Google as the primary search engine and their searching strategies (discussed in Section 5.3.1), based on queries, navigation and information processing allowed them to find adequate information to successfully complete complex tasks. Few participants in AUG used similar techniques and most failed to build the table, in contrast to AAG participants, who surprisingly persisted in searching, performing and completing tasks to ensure accessibility.

The complexity of the task did not affect the tendency of AAG participants to search for information to accomplish tasks; rather, it empowered their persistence to continue with the tasks. They spent more time, made a substantial effort and attempted to adapt and implement codes, despite their low HTML skills and accessibility knowledge. Such behaviours may have resulted from the awareness session, which aimed to increase participants' knowledge and draw their attention to accessibility concepts and the importance of HTML elements to provide accessible content. In addition to these factors, the ease of use of educational sites for web technology languages such as W3Schools contributed to the successful accomplishment of tasks. This finding is consistent with that of Griffiths (1996, as cited in Jillian R. Griffiths & Brophy, 2005), who found that:

> increasing the cognitive burden placed on the user . . . can affect successful retrieval of information. Where an application required fewer actions from the user, greater success was achieved as there was less possibility for a user to make an error. (p. 203)

Time was another factor in participants' behaviour dealing with task complexity. Given that the participants in AAG were more dedicated to completing the most complex task—the table—they spent more time in searching and implementing the task to ensure some level of accessibility. The difference between the two groups when seeking codes to build the table or developing the web pages (discussed in Section 4.4.1) was noteworthy. Compared with AUG, AAG participants spent a considerable amount of time on the web CMS page, which included the table task. This was apparent in the difference in the average time spent on developing the pages and searching the web. To find information, participants in AAG spent an average of 23.33 minutes compared with those in AUG, who spent an average of 14 minutes. Interestingly, the amount of time spent by the AAG participants exceeds that found in Jillian R. Griffiths and Brophy (2005) study:

> Students were asked to search for as long (or short) a time as they wanted provided that they spent no longer than 30 minutes on any one service. This upper limit was imposed as a result of other research, which found that the average time taken to search for information is between 15 and 19 minutes. The majority of students in this study spent an average of between 1 and 15 minutes searching for information. (p. 11)

Similarly, to perform tasks, participants in AAG spent an average of 25 minutes which, again, surpassed the time found in the work of Craven and Griffiths and that of Griffiths and Brophy (2005). It should be noted that for Griffiths and Brophy's (2005) study, student participants were given a limit of 30 minutes to locate information, which influenced their decisions to stop because they were frustrated by time constraints, strategies to adopt, internet speed or habits (e.g. teatime). In the present study, although participants were allocated only two hours to develop the entire site, most did not complain about the short amount of time and, in general, most AAG participants completed the table (which was ranked as the most challenging task) within the allocated time. This was an outstanding result derived from this research. Participants allowed adequate time to seek information and effectively complete tasks. These results reflect the view of Stallings (1980) that 'many educators are now convinced that if student time on task is increased, an increase in student achievement will follow' (p. 11).

Participants' achievements were improved by the efforts made during website development. To reduce complexity and accomplish complex tasks, participants were required to make some effort to search for adequate information and apply it accurately. As discussed in Sections 4.4.2 and 5.2.5, a significant number of participants in AAG excelled in copying and adjusting the retrieved codes to their websites—this effort was worthwhile because it allowed them to build, in most cases, accessible output for the table task.

Given that the default toolbar in the WordPress WYSIWYG editor did not have options for building a table and the plug-in for creating the table had been deliberately disabled, the only way for participants to complete the task was to either build it or to leave it. AAG participants had no mark-up skills but gained some level of HTML knowledge during the awareness session, which could be seen in the changes in their responses to questions in the pre- and post-tests. This improvement was shown to be significant by the paired *t*-test (Table 4.37) and in the way the participants attempted the build the table. Participant efforts were driven by both the complexity of the task and the assigned goal.

The present research indicates that the degree of complexity influences the effort participants make to complete tasks. When the participants in AAG were engaged in different tasks, they spent more time on the web CMS page than on other pages. The reason for this behaviour was that the table was found on that page and participants were involved in implementing accessible HTML elements for that specific task. The results showed that the efforts made contributed to more significant outcomes. In contrast, AUG participants made only a basic effort or no effort in complex tasks. This result is consistent with the findings of Gwizdka (2013), who reported in his conclusion that:

> In this study, we examined user behavior on information search tasks at two levels of complexity and for two users groups characterized by differences in their working memory span. The results show that in more demanding task conditions both user groups change behavior, but they differ in how they change it. High-WM user performed more actions to find more information, while low-WM users changed their behavior by visiting significantly fewer documents. (p. 7)

Task complexity was not the only factor that influenced the efforts made by participants to complete tasks. The goal of this research was also influential. During the awareness session, AAG participants became aware of the importance of implementing accessible components in their websites using HTML elements. When implementing components, AAG participants were keen to achieve that goal; therefore, they focused on using practical strategies to seek information they could use to achieve their objectives. Paquette and Kida (1988) found that strategies selected by the decision-maker depend on task complexity (p. 128), adding that, 'With low task complexity, decision-makers often use full processing strategies, while an increase in task complexity typically results in the use of reduced processing strategies to reduce cognitive effort' (p. 129). This finding applies to the behaviour of the participants in AAG, whose strategy selection depended upon task complexity—this was apparent in their research behaviours and strategies adopted (explained in Section 5.3.1) when seeking information.

An interesting finding that emerged from this research is that the complexity of the task did not impede task completion, especially for participants in the awareness group. Outcomes show that the more complex the task, the greater the focus on that task. Participants' search strategies, persistence in looking for suitable information and ability to adapt that information (codes) to their situation, as well as the time and effort they allocated to these tasks, were substantial returns of the awareness session.

6.4 Web CMS and Web Content Output

6.4.1 Main Research Question

Can the use of web CMSs with accessibility features lead to improved accessibility outcomes for novices?

The response to the principal question of this study relies on the further consideration of some elements before addressing this question. The selection of WordPress for this research was based on its popularity, potential and features, three valuable components of a reliable system that met the requirements of this research.

Web CMSs are known to be used by people with no technical skills. Even though they are recognised for their usability, novice users, such as the participants in this study, may be unable to produce accessible content if they are unfamiliar with the system's potential regarding its features or capabilities. Nowadays, numerous web CMSs are available on the market, making it difficult for people to select an adequate system. However, users in general select systems that respond to their requirements, are prominently used and are updated by a community that aims to continually improve its strengths.

WordPress is used by a large community worldwide, and its popularity has been an impetus for improvement. The community is involved in enhancement of the system to make it more efficient and accessible. Additionally, the WordPress accessibility team contributes to its development with respect to accessibility, with the aim of providing a tool that responds to the needs of all users, particularly those with special needs. This collaboration enhances its functionality, ease of use and abilities to satisfy user needs. Functionalities of WordPress may be extended using additional accessible templates, plug-ins, themes and widgets. Additionally, the system's editor provides all necessary options for creating accessible content in that users can change, modify or add features to the content to make it accessible.

WordPress presents ready-to-use tools and functionalities and its environment allows users to add and adjust content to make it accessible. As discussed, participants made substantial use of the system and its components to produce content with some level of accessibility. Participants who created relatively accessible websites were those in the awareness group. This outcome implies that a web CMS that incorporates accessibility features does not automatically apply accessibility to the content but allows that accessibility to be implemented via built-in features and system editors (i.e. text and visual modes).

Further, an accessible outcome does not rely only on using a system that incorporates accessibility but on a range of factors, including knowledge, skills, adopted strategies, efforts made and raising awareness. Use of the system to develop websites would not necessarily have produced accessible output had participants not been supported by the material provided in the awareness session. Without that support, it would have been impossible for them to use the system efficiently or even to think about implementing accessible HTML elements, unfamiliar concepts for almost all participants. The use of an accessible web CMS by novice users may partly lead to accessible outcomes because accessibility depends on the system, its external contributors and user attitudes towards accessibility. An example from the literature states that 'the user's ability to make an accessible website ultimately matters more on the user's knowledge of the CMS and web accessibility, rather than the CMS itself' (Putland, n.d., as cited in Jenkinsen, 2016a, para. 18).

6.5 Research Limitations

This research has ascertained the effects of awareness and the use of an accessible web CMS on outcomes when accompanied with other contributing factors; however, this study has some limitations related to sample, session time and resources.

First, given the purpose of this research, students from four disciplines at ECU were invited to volunteer. Only 30 students accepted the invitation; therefore, sample size was lower than expected. Even if results were significant, the sample size limited statistical analysis and restricted the generalisation of results to all novice users. According to Faber Faber and Fonseca (2014), a relevant sample 'renders the research more efficient: Data generated are reliable, resource investment is as limited as possible while conforming to ethical principles' (p. 29).

Second, the total time allocated to the awareness session was three hours. During the session, the time allocated for awareness training, website development and pre- and post-tests was insufficient. Increasing the time allocated for sessions would be more effective for testing the effects of awareness training on participants learning outcomes. Despite AAG participants being dedicated to providing accessible outcomes and all participants attempting to complete tasks within the time boundaries, future research could address this time constraint to increase the benefits of the awareness session. However, in the real world, the need to leave a period of time between the learning phase and the testing phase would be a considerably interesting, with regards to the achievements.

The third and final limitation of this study is related to the limited resources to support the current study. Core concepts, tools and methods are abundant in the literature. However, there has been little research about the effects of awareness and accessible web CMSs on content output by novice users. This research attempted to highlight the need for all organisations to implement accessibility features in their websites and teach their employees to use systems and build websites with a focus on accessibility. Further research could conduct more in-depth investigations on that topic to enrich the literature and provide a broader vision of the topic.

6.6 Recommendations for Future Research

The findings of this study have some critical implications for future action. Given the gap in the knowledge about the use of tools and awareness sessions to produce accessible outcomes, future studies may fill this gap addressing the limitations of this study, including sample size and the time allocated to accessibility awareness and the creation of website content.

The results obtained from this study were significant and useful as they highlight the importance of awareness on accessibility and its environment (e.g. tools, guidelines, skills, knowledge and behaviours). Although these concepts were applied and used by the participants in this research, sample size was small and participants were drawn from only four disciplines at one university; therefore, generalisation of results should be done cautiously. Expanding the research field (i.e. more universities) and number (i.e. more participants) would be likely to produce more reliable outcomes as long as it does not affect statistical test results: 'Very large samples tend to transform small differences into statistically significant differences' (Faber & Fonseca, 2014, p. 29).

Another topic of interest is the time allocated for accessibility awareness. Awareness has the potential to improve skills and knowledge of website builders, including designers, developers and novice users. As accessibility is frequently not considered by developers for numerous reasons (e.g. the belief that it is not required, its time-consuming nature and complexity of guidelines), the impetus of emphasising this subject would benefit the larger community. Future work could focus on the amount of time needed for accessibility awareness prior to website development. This may provide support for organisations in teaching accessibility and guidelines and allowing time for comprehension of concepts before development of accessible websites.

The final recommendation for future work is the development of websites using HTML elements aimed at providing accessible content for the entire website. This type of study requires prior knowledge of mark-up language so that users do not spend time learning HTML rather than learning accessibility concepts. The research design could be similar to that of this study to identify any differences between the two approaches and to confirm the results of this study.

6.7 Concluding Remarks

The effects of awareness and the use of an accessible web CMS on outcomes were the principal aims of this research. A mixed methods approach was used, incorporating three instruments (survey, pre- and post-tests), the development of websites by participants of two groups, AAG and AUG, and records of their actions to determine the effects of awareness along with an accessible tool on outputs. This goal was addressed by the main research question and three supportive questions, which primarily asked whether the use of an accessible web CMS by novice users would lead to the output of accessible web content and how accessibility awareness would influence their website development, behaviours and accomplishments.

One of the more significant findings to emerge from this study was that the use of an accessible web CMS on its own does not guarantee accessible outcomes if it is not accompanied by other elements related to accessibility (e.g. guidelines, HTML knowledge, user involvement and user competencies). The study also identified time as one factor contributing to conducting an efficient search and applying a sufficient effort to implementing accessible components. Nevertheless, fatigue associated with time length negatively influenced participant performance in website development, which was observed in the greater effort applied in the early stages and the 'copy and paste' approach observed in the later stages.

Another important finding is that when participants were not aware of accessibility and lacked skills and knowledge in accessibility and mark-up language, they tended to mimic and focus on the appearance of pages rather than on accessibility of content. Given the paucity of information on this topic, further research is warranted to confirm this finding.

This study has shown the positive benefits of awareness and an accessible system on outputs. Organisations should be encouraged to incorporate awareness sessions to improve their employees' knowledge about accessibility and W3C guidelines and to increase their ability to select and use adequate tools that provide desired outputs. In general, it appears that awareness is an essential key for increasing sensitivity towards accessibility.

Awareness is a key ingredient in success. If you have it, teach it, if you lack it, seek it.

—Michael B. Kitson (1926–1998), art historian.

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APPENDICES

APPENDIX A: RESEARCH INSTRUMENTS

Survey Questionnaire

Web Accessibility Survey

Thank you for accepting to be a part of this survey. This will provide useful information that will contribute to the outcome of our study. This survey will take 5 to 10 minutes to complete. As you enter your Participant ID below, please be assured that no identifying data about you will be presented in the final thesis.

Please enter the code provided to you for this survey: ___________________________

Q1**. Participant information, the Web use and experience**

This section will help in providing general information of participants, their experience and use of the Web.

Q1.1 **Please specify your gender.**

- ○ Male (1)
- ○ Female (2)

Q1.2 **What is your age group?**

- ○ < 20 (1)
- ○ 20–30 (2)
- ○ 30–40 (3)
- ○ 40–50 (4)
- ○ 50–60 (5)
- ○ ≥ 60 (6)

Q1.3 **For how long have you been using the internet?**

- ○ < 1 year (1)
- ○ 1–2 years (2)
- ○ 2–3 years (3)
- ○ 3–4 years (4)
- ○ 4–5 years (5)
- ○ 5–6 years (6)
- ○ ≥ 5 years (7)

Q1.4 **How often do you access the internet?**

- ○ Always (1)
- ○ Very often (2)
- ○ Sometimes (3)
- ○ Rarely (4)
- ○ Never (5)

Q1.5 **What you are using the internet for?**

- ○ To study (1)
- ○ To socialise (2)
- ○ To play games (3)
- ○ Other (please specify) (4) ____________________

Q1.6 **What is your experience level in using the Web?**

- ○ Very good (expert) (1)
- ○ Good (confident user of the Web) (2)
- ○ Medium (mostly confident in use of the Web) (3)
- ○ Low (occasionally need help from others) (4)
- ○ Very low (often need help from others) (5)
- ○ Other (please specify) (6) ____________________

Q2 **The Web Accessibility**

This section will provide information of your understanding and opinion on the Web Accessibility.

Q2.1 **How do you evaluate your understanding of the Web Accessibility concept before this study?**

- ○ Very good (1)
- ○ Good (2)
- ○ Fair (3)
- ○ Poor (4)
- ○ Never heard of it (5)

Q2.2 **How do you evaluate your understanding of the Web Accessibility concept when participating in this study this study?**

- ○ Very good (1)
- ○ Good (2)
- ○ Fair (3)
- ○ Poor (4)
- ○ Cannot say (5)

Q2.3 **In your opinion, should the Web be usable by any person, regardless of disability?**

- ○ Very important (1)
- ○ Important (2)
- ○ Relatively important (3)
- ○ Not important (4)
- ○ I don't know (5)

Q2.4 **When do you think the Web Accessibility should be considered?**

- ○ All the time (1)
- ○ When is required (2)
- ○ Not considered at all (3)
- ○ I don't know (4)
- ○ Other (please specify) (5) ____________________

Q2.5 **If you are involved in developing a website, would you consider implementing Web Accessibility guidelines?**

- ○ Always (1)
- ○ Depends on the site's intended audience (2)
- ○ Depends on the time and cost (3)
- ○ Probably not (4)
- ○ Never (5)

Skip To: Q2.7 if Q2.5 = Probably not or Never

Q2.6 **What is/are the reason(s) of considering the accessibility when developing a website (please explain your response)?**

____

____

____

____

Skip To: End of Block If Q2.6 Is Not Empty

Q2.7 **What is/are the reason(s) of not considering the accessibility when developing a website (please explain your response)?**

____

____

____

____

Q3 **Web Accessibility guidelines**

This part will provide useful information on your use, experience and opinion on the accessibility guidelines.

Q3.1 **Have you been a part of the Accessibility awareness trained group in this survey?**

- ○ Yes (1)
- ○ No (2)

Skip To: End of Block If Q3.1 = No

Q3.2 **Did you consult W3C materials for the accessibility guidelines?**

- ○ Yes (1)
- ○ No (2)

Skip To: Q3.6 If Q3.2 = No

Q3.3 **Did you find them difficult to understand?**

- ○ Yes (1)
- ○ No (2)

Skip To: End of Block If Q3.3 = No

Q3.4 **Did you find them easy to interpret and apply?**

- ○ Yes (1)
- ○ No (2)

Q3.5 **What was/were the problem(s) you find when applying the Accessibility Guidelines?**

____
____
____
____

Q3.6 **Which function you find was the most difficult to understand? (Please, rank from the most to the least by dragging the mouse down or up and drop)**

______Headings (1)
______Links (2)
______Videos (3)
______Table (4)
______Structure (5)

Q3.7 **If in the future you have the opportunity to develop a website are you going to consider the Accessibility Guidelines?**

- ○ Yes (1)
- ○ No (2)
- ○ Not sure (3)

Q4 **Web Content Management System (Web CMS): WordPress**

This section will permit us to gain information about your experience in using WordPress

Q4.1 **Do you think that the WordPress was easy to use?**

- ○ Yes (1)

- No (2)
- Cannot say (3)

Skip To: Q4.3 If Q 4.1 = Yes

Q4.2 **What difficulties did you encounter using WordPress overall? (please specify)**

____
____
____
____

Q4.3 **How did you find the level of difficulty in applying the required research tasks in WordPress?**

- Very hard (1)
- Easy (2)
- Varied from task to task (3)
- Cannot say (4)

Q4.4 **Did you switch to the HTML editor when adding the pages' content?**

- Yes (1)
- No (2)

Skip To: Q4.6 If Q4.4 = Yes

Q4.5 **If you did not switch to the HTML editor, was there any specific reason?**

____
____
____
____

Q4.6 **Did you find that you could apply all the accessibility requirements using the options provided by the Web Content Management System interface?**

- Yes (1)
- No (2)

Skip To: Q4.8 If Q4.6 = Yes

Q4.7 **Why you could not apply the accessibility requirements provided by the Web Content Management System? (Please explain)**

____
____
____

Q4.8 **Was it easy to identify the accessibility related options when adding content to the system?**

- Yes (1)
- No (2)

Skip To: Q4.10 If Q4.8 = Yes

Q4.9 **Why it was not easy to identify the accessibility related options when adding content to the system? (Please explain)**

____
____
____

Q4.10 **What were the three features you liked most in WordPress?**

____
____
____

Q4.11 **What were the three features you disliked most in WordPress?**

____
____
____
____

Q4.12 **Would you use or recommend the use of WordPress to others with an interest in accessible web design?**

- ○ Yes (1)
- ○ No (2)
- ○ I don’t know (3)

Q 5 Awareness Session

This section will provide information about the awareness session and your suggestions for improving this aspect.

Q5.1 **What are your overall views on the accessibility awareness session materials?**

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Improved my knowledge on accessibility (1)					
Was useful for my learning (2)					
Was unnecessary (3)					
Did not seem relevant (4)					

Q5.2 **What is your opinion on the level of the accessibility awareness session materials?**

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
Clear and understandable (1)					
Simple and useful (2)					
Short and coherent (3)					
Complex and incomprehensible (4)					

Q5.3 **How was accessibility awareness session time?**

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
Too long (1)					
Just right (2)					
Too short (3)					

Q 5.4 **What do you think about the awareness session environment (i.e. room and delivery process)?**

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Agreeable (1)					
Appropriate (2)					
Unsuitable (3)					

Q5.5 **How were the awareness session expectations in terms of raising your awareness of web accessibility?**

	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Satisfactory (1)					
Unsatisfactory (2)					

Q5.6 **What are your suggestions regarding the accessibility awareness material (Please discuss)?**

____

____

____

Pre-Test Questionnaire

Web Accessibility Pre-Test

Thank you for accepting to be a part of this research. This is the pre-test component of the study and will help provide useful information that will contribute to the outcome of our study. This test will take 3 to 5 minutes to complete. As you enter your Participant ID below, please be assured that no identifying data about you will be presented in the final thesis.

Please enter the Participant ID provided to you for this survey: ________________________

Q1 **Web and Accessibility**

This section will help us understand what you know about web Accessibility

Q1.1 **Are you involved in web accessibility (i.e. as a developer, tester, auditor etc.)?**

- ○ Yes (1)
- ○ No (2)

Skip To: Q1.3 If Q1.1 = No

Q1.2 **If you are employed full time or part time, could you briefly describe your occupation?**

____

____

____

Q1.3 **What does the term web Accessibility mean to you?**

- ○ Equal access for everyone (1)
- ○ Barrier free to access the Web (2)
- ○ People with disabilities and elderly people can access the Web (3)
- ○ Websites that load on mobile devices (4)
- ○ All of the above (5)
- ○ I don’t know (6)

Q1.4 **What categories of disability are you familiar with?**

- ○ Physical (1)
- ○ Hearing (2)
- ○ Visual (3)
- ○ Cognitive (4)
- ○ Leaning impairment (5)
- ○ Other (please specify) (6) ____

Q1.**5 Do you know the term that is used to describe technologies which allow people with disabilities to use the Web?**

- ○ Practical technologies (1)
- ○ Assistive technologies (2)
- ○ internet technologies (3)
- ○ Civic technology (4)
- ○ I don't know (5)

Q2 **Hyper Text Markup Language (HTML)**

This section will assist us in gaining knowledge as to your understanding of accessible HTML.

Q2.1 **Which of the following elements do not need to be closed with a set of end tags </>?**

- ○ <pre> (1)
- ○ (2)
- ○ <hr> (3)
- ○ <p> (4)
- ○ <div> (5)
- ○ I don't know (6)

Q2.2 **Which HTML element should be used for the topmost heading in a document?**

- ○ <head> (1)
- ○ <heading> (2)
- ○ <h1> (3)
- ○ <h5> (4)
- ○ I don't know (5)

Q2.3 **What is the correct approach to placing a code comment in a HTML document?**

- ○ (this is a comment) (1)
- ○ // This is a comment (2)
- ○ / this is a comment (3)
- ○ <!--this is a comment--> (4)
- ○ I don't know (5)

Q2.4 **Which of the following do you think is an example of accessible HTML for the headings?**

- ○ <h1>Hello everybody</h1> <h2>Hello everybody</h2> <h3>Hello everybody</h3> (1)

○ <h2>Hello everybody</h2> <h1>Hello everybody</h3> <h3>Hello everybody</h1> (2)

○ <h2>Hello everybody</h3> <h1>Hello everybody</h2> <h3>Hello everybody</h1> (3)

○ None on the above (4)

○ I don't know (5)

Q2.5 **Which of the following do you think is an example of accessible HTML for the image?**

○ <IMG SRC="image.jpg"> (1)

○ <img src="image.jpg" alt="Citylights: your access to the city."> (2)

○ <IMG SRC=““ alt="Citylights> (3)

○ None of the above (4)

○ I don't know (5)

Q2.6 **If I wanted a table with three columns in it, which of the following HTML approaches would I use?**

○ <table cols="3"> (1)

○ <tr><td></td><td></td></tr> (2)

○ <tr cols="3"> (3)

○ <table rows="5" colrows="3"> (4)

○ I don't know (5)

Q2.7 **Which of the following do you think is an example of accessible HTML for the table?**

○ <TABLE>
<TR>
<TD> Peaches</TD>
<TD> Pears</TD>
<TD> Apples</TD>
</TR>
</TABLE> (1)

○ <TABLE summary ="Comparison of fruit prices by cities" border = "1" <width="300">
<caption><u>Table 1</u>:Fruit prices in New York </caption>
<head>
<tr> <th> Peaches </th><th> Pears</th> <th> Apples</th>
<tr> <align="center"> <td>$2</td> <td>$6</td> <td>$7</td> </tr>
</TABLE> (2)

○ <TABLE summary ="Comparison of fruit prices by cities"> <caption>Fruit prices in different cities</caption>

<tbody> <thead>
<tr>
<th> Peaches</th>
<th> Pears</th>
<th> Apples</th>
</tr>
<tr>
<th abbr ="NY" colspan="4">New York</th>
</tr>
<tr>
<th>Canned</th>
<td>$2</td>
<td>$4</td>
<td>$3</td>
</tr> </tbody>
</thead>
</TABLE> (3)

- None of the above (4)
- I don't know (5)

Q2.8 **Which of the following do you think is an example of accessible HTML for the hyperlink?**

- Overview (1)
- Overview (2)
- <a href="http://Access.com/Overview.htm Overview (3)
- None of the above (4)
- I don't know (5)

Q2.9 **Which of the following do you think is an example of accessible HTML for the text colour?**

- <h1 style=color:blue> This is an example</h1> (1)
- <h1 style= "color:blue"> This is an example</h1> (2)
- <h1 style: color=blue> This is an example</h1> (3)
- None of the above (4)
- I don't know (5)

Q2.10 **Which of the following do you think is an example of accessible HTML to embed a video into a web page?**

- <video width="320" height="240" autoply> <source src= "test.mp4" type ="video/mp4"> </video> (1)
- <video width="320" height="240" autoply source = src = "test.mp4" type="video/mp4"></video> (2)

- ○ <video width="320" height="240" autoply source = src = "test.mp4"><source type="video/mp4" autoply></video>(3)
- ○ None of the above (4)
- ○ I don't know (5)

Q3 **W3C**

This section will allow us to understand your knowledge of the W3C

Q3.1 **What does the acronym W3C stand for?**

- ○ The Web Wide Web Conglomeration (1)
- ○ The World Wide Web Consortium (2)
- ○ The World Web Wide Confederation (3)
- ○ I don't know (4)

Q3.2 **What is the role of the W3C?**

- ○ Contribute to the evolution of the Web (1)
- ○ Develop Protocols (2)
- ○ Develop HTML and Markup Standards (3)
- ○ All of the above (4)
- ○ I don't know (5)

Q3.3 **What does the acronym WCAG stand for?**

- ○ Web Content Authoring Guidelines (1)
- ○ Web Content Accessibility Guidance (2)
- ○ Web Content Accessibility Guidelines (3)
- ○ None of the Above (4)
- ○ I don't know (5)

Q3.4 **What does the acronym ATAG stand for?**

- ○ Accessibility Tools for Authoring Guidelines (1)
- ○ Authoring Tools Accessibility Guidelines (2)
- ○ Authoring Techniques Accessibility Guidelines (3)
- ○ None of the Above (4)
- ○ I don't know (5)

Q4 **Web Content Management Systems (WCMS)**

This section will allow us to gain some understanding of your WCMS knowledge

Q4.1 **Have you heard the term 'Web Content Management System' (WCMS) before?**

- ○ Yes (1)
- ○ No (2)

Skip To: End of Survey If Q4.1 = No

Q4.2 **From your understanding, what is the benefit of using a WCMS for managing Web content?**

____
____
____

Q4.3 **List at least three Web Content Management Systems you have heard of.**

____
____
____
____

Q4.4 **List any Web Content Management Systems you have used before, including what tasks you completed in them.**

____
____
____
____

Post-Test Questionnaire

Web Accessibility Post-Test

Thank you for accepting to be a part of this research. This is the post-test component of the study and will help provide useful information that will contribute to the outcome of our study. This test will take 3 to 5 minutes to complete. As you enter your participant ID below, please be assured that no identifying data about you will be presented in the final thesis.

Please enter the participant ID provided to you for this test: ______________________________

Q1 **Web and Accessibility**

This section will help us to understand what you learnt about web accessibility

Q1.1 **What does the term Web Accessibility mean to you?**

- ○ Equal access to everyone (1)
- ○ Barriers free to access the Web (2)
- ○ People with disabilities and elder people can access the Web (3)
- ○ Websites that load on mobile devices (4)
- ○ All of the above (5)
- ○ I don't know (6)

Q1.2 **What categories of disability do you become familiar with?**

- ○ Physical (1)
- ○ Hearing (2)
- ○ Visual (3)
- ○ Cognitive (4)
- ○ Leaning impairment (5)
- ○ Other (please specify) (6) ____

Q1.3 **Do you learn the term that is used to describe technologies which allow people with disabilities to use the Web?**

- ○ Practical technologies (1)
- ○ Assistive technologies (2)
- ○ internet technologies (3)
- ○ Civic technology (4)
- ○ I don't know (5)

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This section will assist us in gaining knowledge as to your learning of HTML

Q2.1 **Which of the following elements do not need to be closed with a set of end tags </>?**

- ○ <pre> (1)
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- ○ / this is a comment (3)
- ○ <!-- this is a comment --> (4)
- ○ I don’t know (5)

Q2.4 **Which of the following do you think is an example of accessible HTML for the headings?**

- ○ <h1>Hello everybody</h1> <h2>Hello everybody</h2> <h3>Hello everybody</h3> (1)
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- ○ <h2>Hello everybody</h3> <h1>Hello everybody</h2> <h3>Hello everybody</h1> (3)
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- ○ I don't know (5)

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<th> Pears</th>
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</tr>
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</tr>
<tr>
<th>Canned</th>
<td>$2</td>
<td>$4</td>
<td>$3</td>
</tr> </tbody>
</thead>
</TABLE> (3)
- ○ None of the above (4)
- ○ I don't know (5)

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- Develop Protocols (2)
- Develop HTML and Markup standards (3)
- All of the above (4)
- I don't know (5)

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- Web Content Authoring Guidelines (1)
- Web Content Authoring Guidance (2)

- ○ Web Content Accessibility Guidelines (3)
- ○ None of the above (4)
- ○ I don’t know (5)

Q3.4 **What does the Acronym ATAG stand for?**

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- ○ Authoring Tools Accessibility Guidelines (2)
- ○ Authoring Techniques Accessibility Guidelines (3)
- ○ None of the above (4)
- ○ I don’t know (5)

Q4 **Web Content Management Systems (WCMS)**

This section will allow us to gain some understanding of your WCMS knowledge.

Q4.1 **From your participation in this research, what is the benefit of using a WCMS for managing web content?**

____

____

____

Q4.2 **List at least three Web Content Management Systems you have heard of?**

____

____

____

Q4.3 **List any Web Content Management systems you have used before, including what tasks you completed in them.**

____

____

____

User Manual

Steps to create web page with WordPress

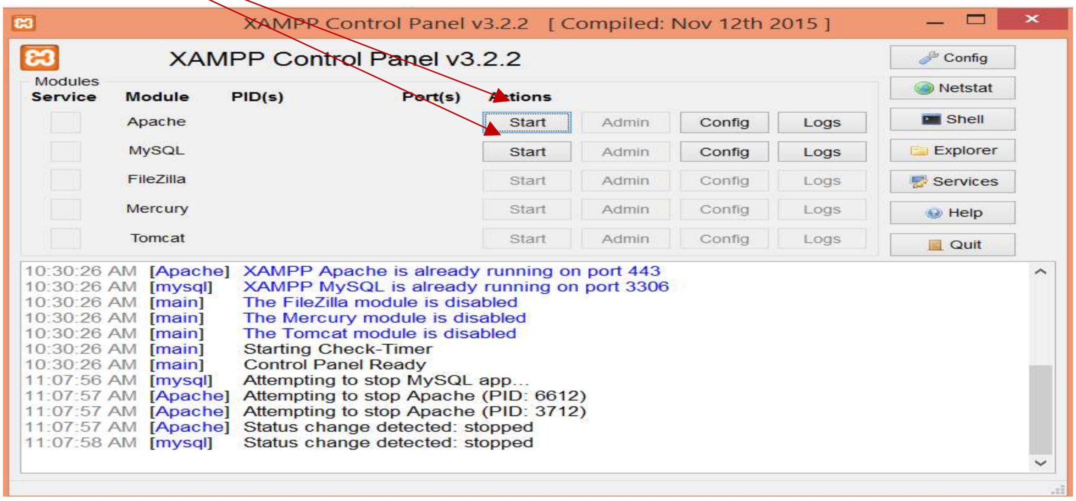
From Desktop open multisite test folder then click on xampp control application, the following screen to start XAMPP will open.

Start XAMPP

Click on XAMPP icon

The following screen will open

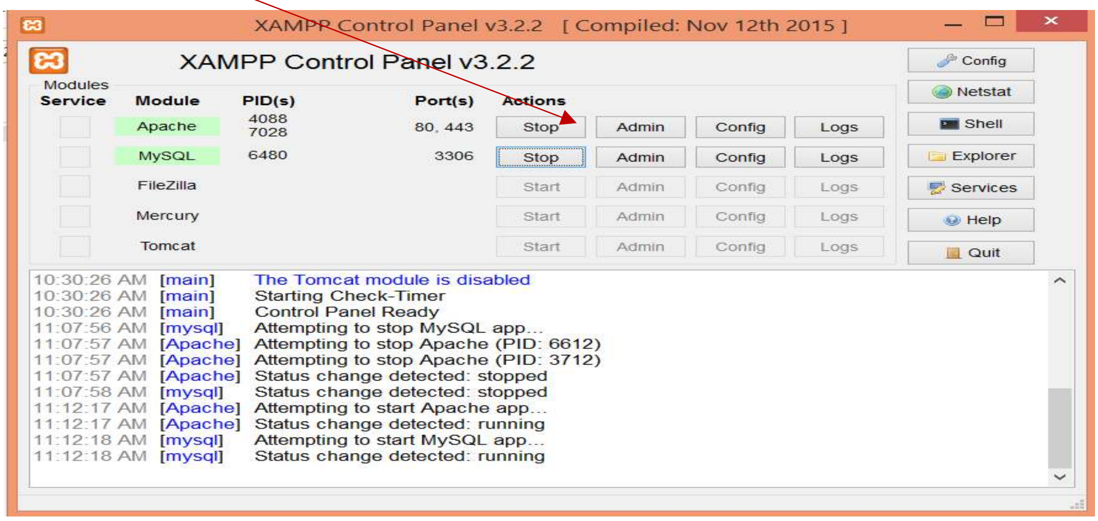
Click here



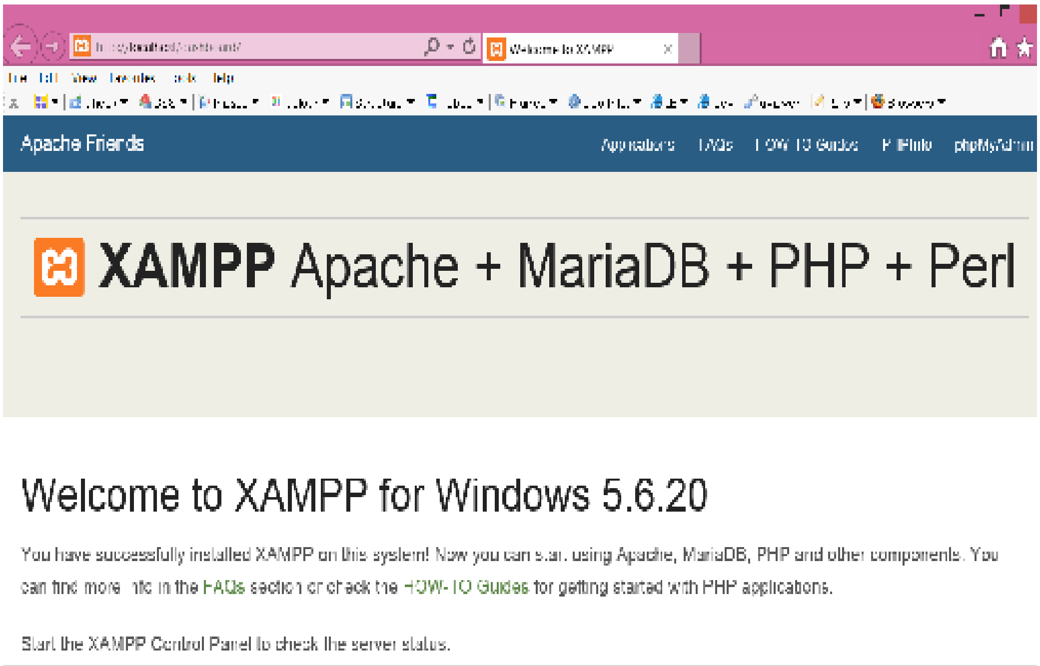
Click on start for both apache and MySQL (as it shown above).

From the above screen, click on Admin (for apache)

Click here



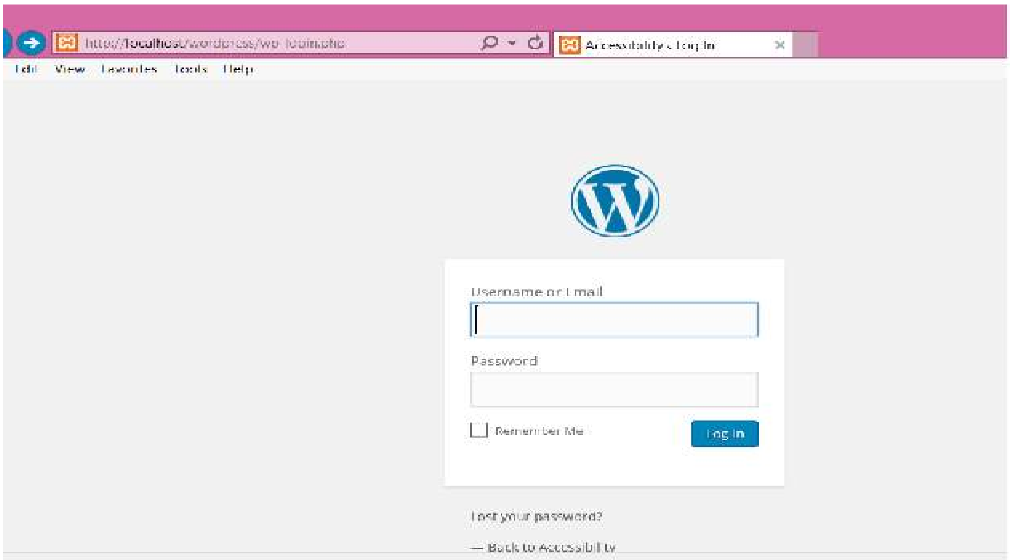
The next window will open



Copy the following to the bar menu

http://localhost/wordpress/wp-login.php

That will open WordPress login page (as shown below). Enter your username and password (as provided to you).

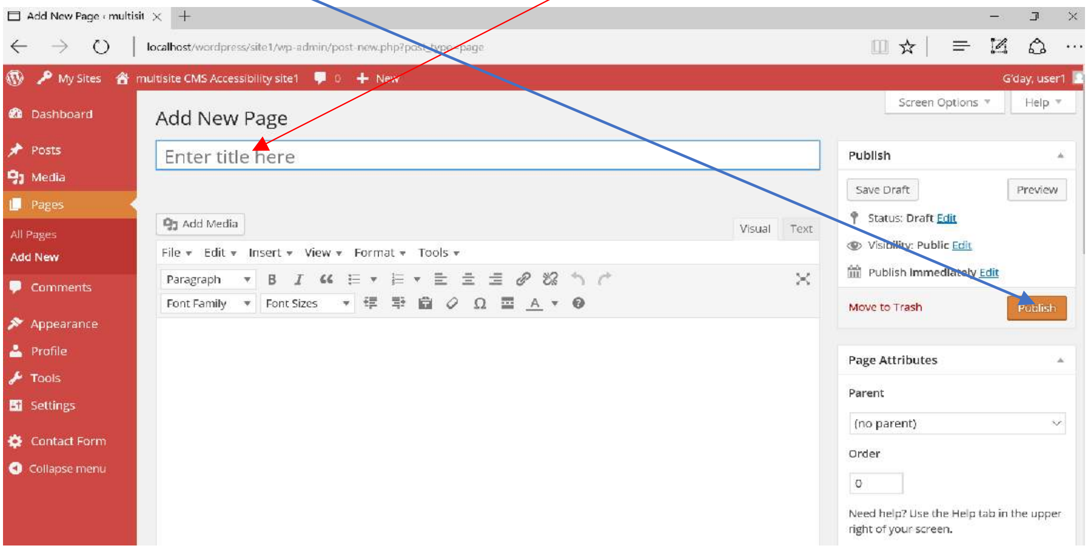


[Work with WordPress]

From WordPress screen you can create the elements of your web page.

Create pages

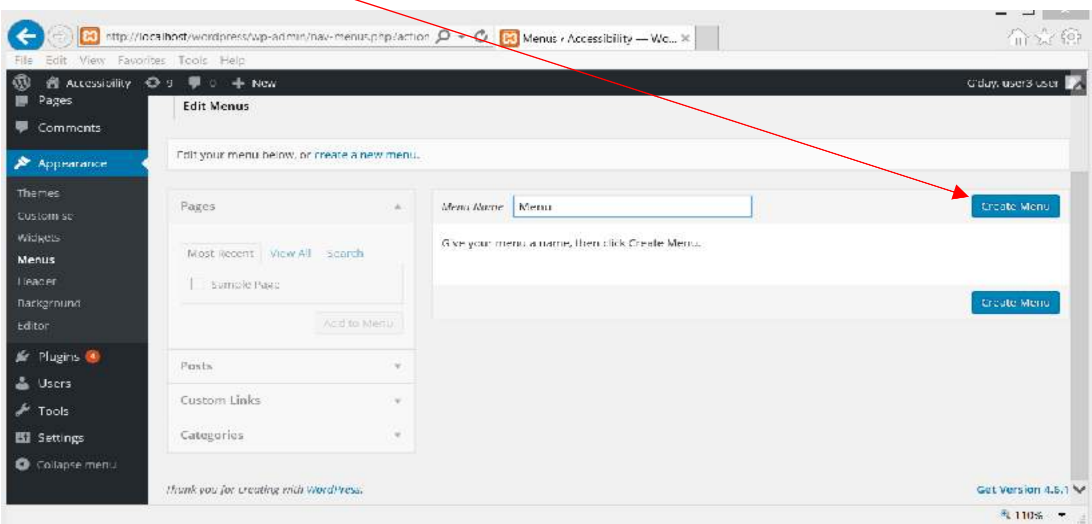
Pages>Add New> Enter the page title in Add New Page box, the content then click on Publish



Define a menu

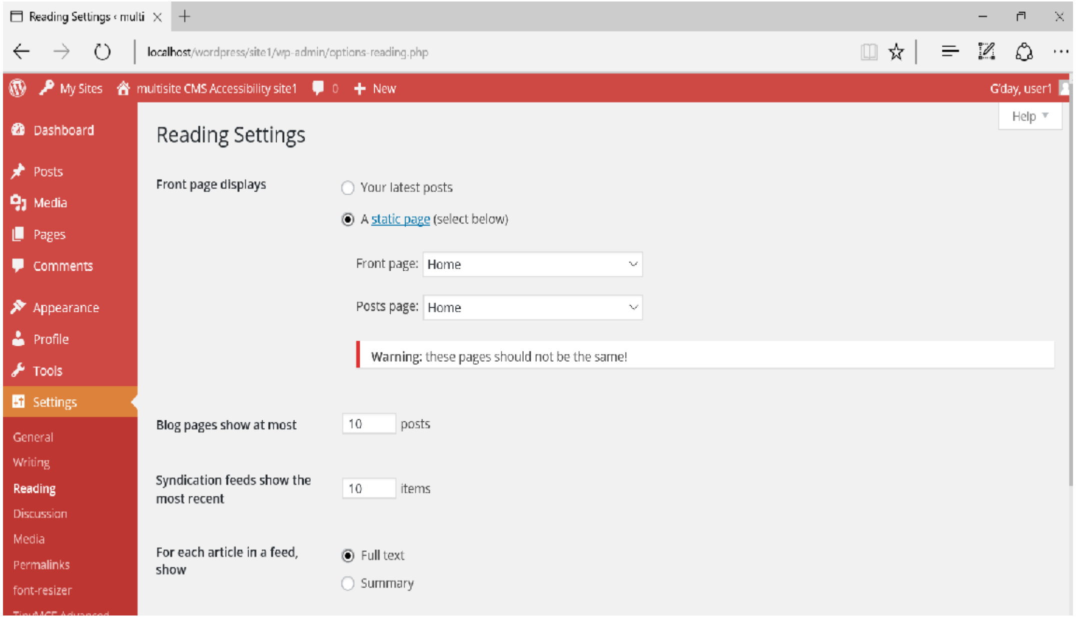
From the Dashboard:

- Appearance>Menus>Give a name to the Menu>Create a new menu
- Click the Create Menu button.



Add pages to the main menu

- Appearance>Menus>Pages>View All> Tick pages to add to the menu> click on Add to menu button> and click on save Menu
- To allow the home page to be displayed, from Dashboard, go to settings>Reading>Select Static Page, Front page, and post page>Save changes.

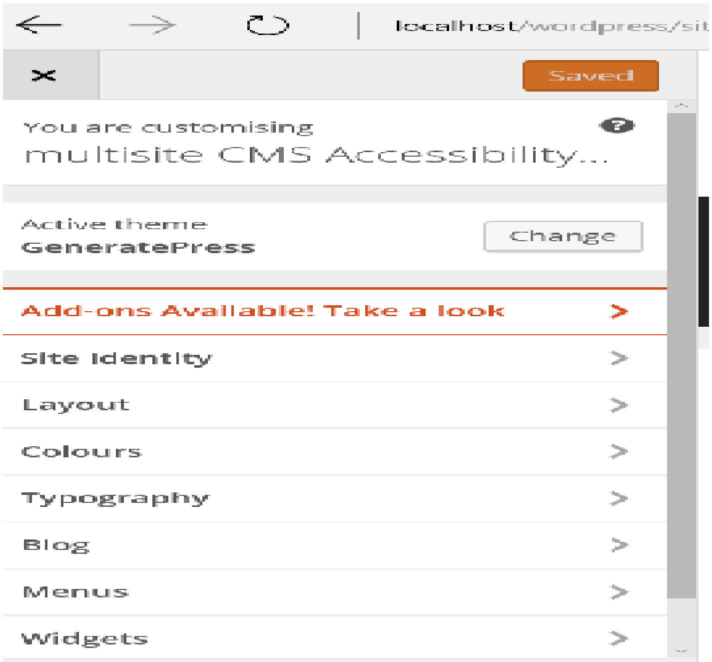


Add theme to the Site

- Appearance>Customise>Active theme>Change>Click on the desired one>Save & Activate

Customise the site

- Appearance>Customise

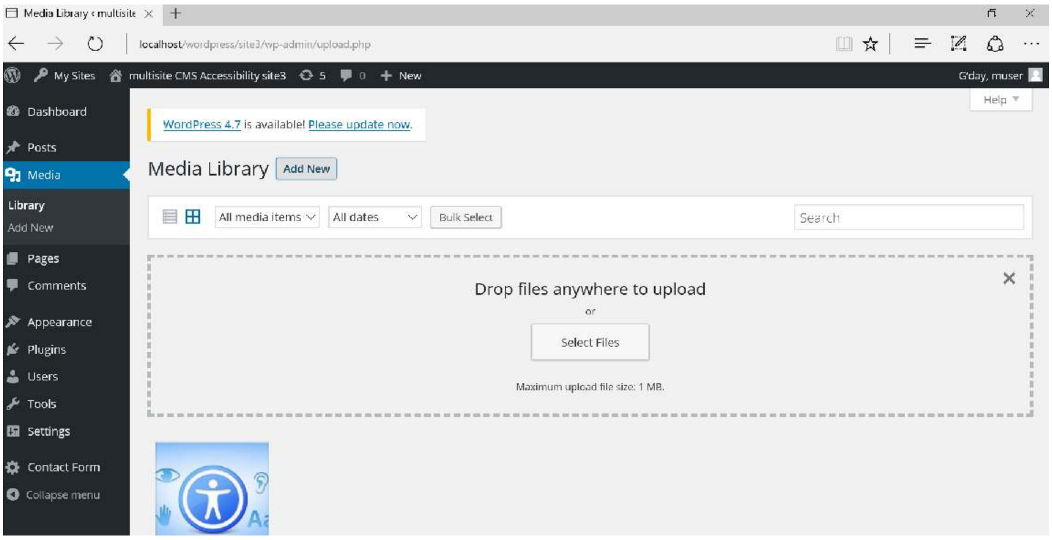


From there you can make changes to the home page (add its content and picture), site title, widget, colour etc.

Add images to the website

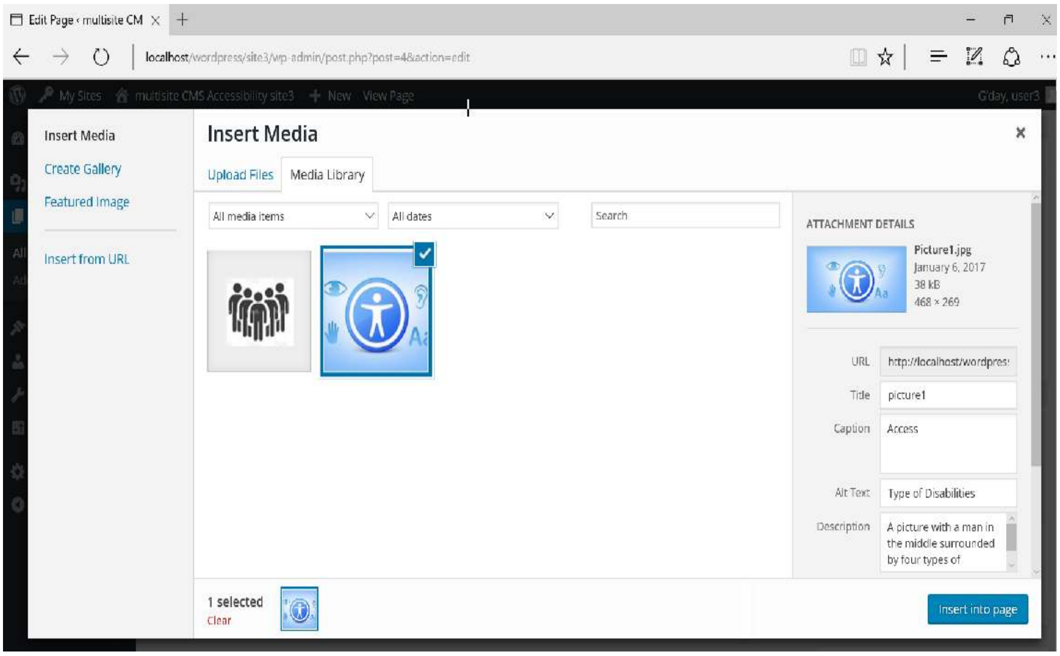
1- Create media Library

Dashboard>Media>Library>Add New>Select files>Open



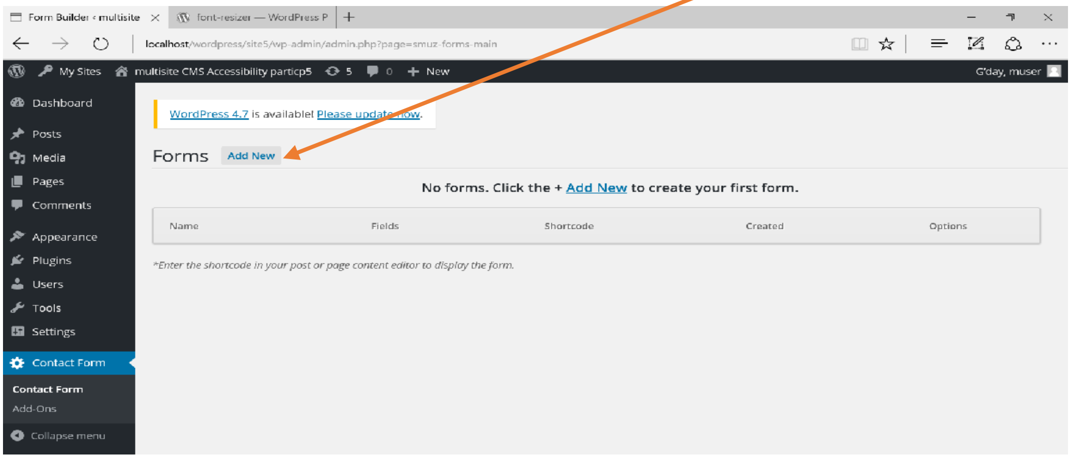
2- Add Picture to a page

In the Text mode, click on Add Media>Select the image wanted> it opens the pictures in the library, select the picture by clicking on it from there you can add caption, alternative text, description, resize image etc. as shown in the screen below (don't forget to click on Update button to save any changes)>Insert into page.

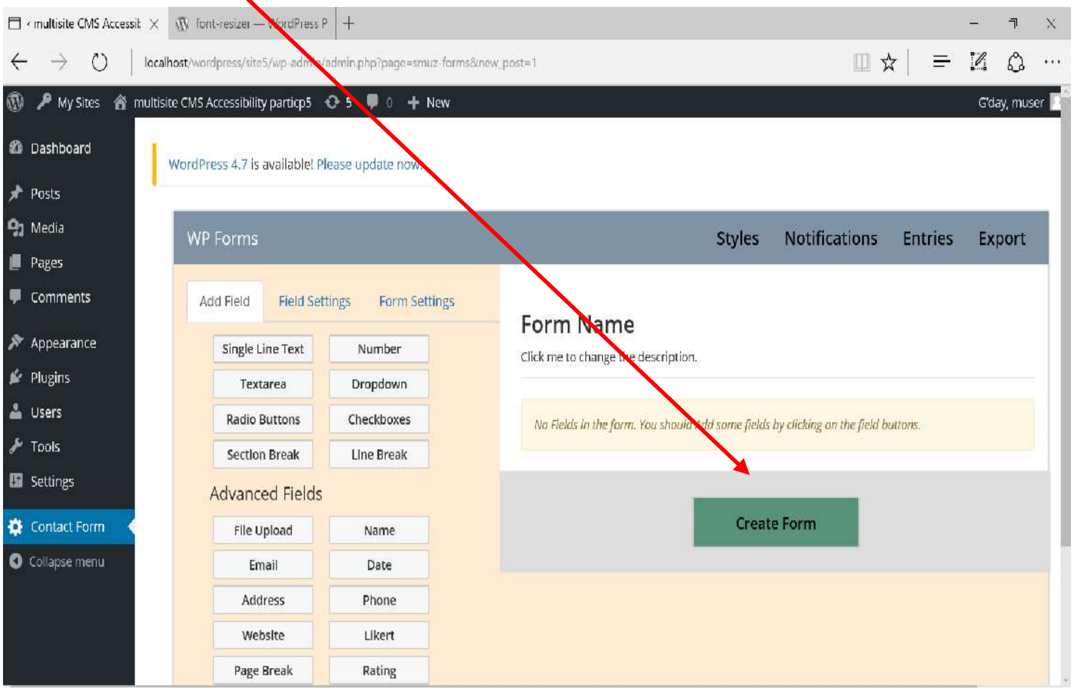


Add Form to a page

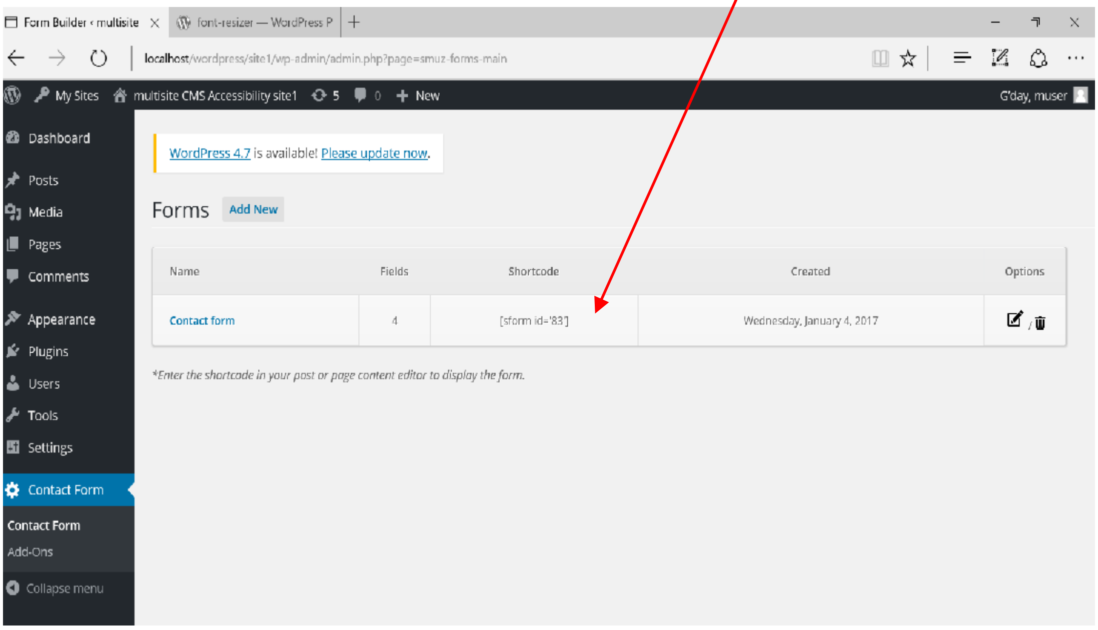
From dashboard, click on contact Form>Contact form> Add New



From Add Field tab click on the fields you want to add in your form and save the form by clicking on create form button.

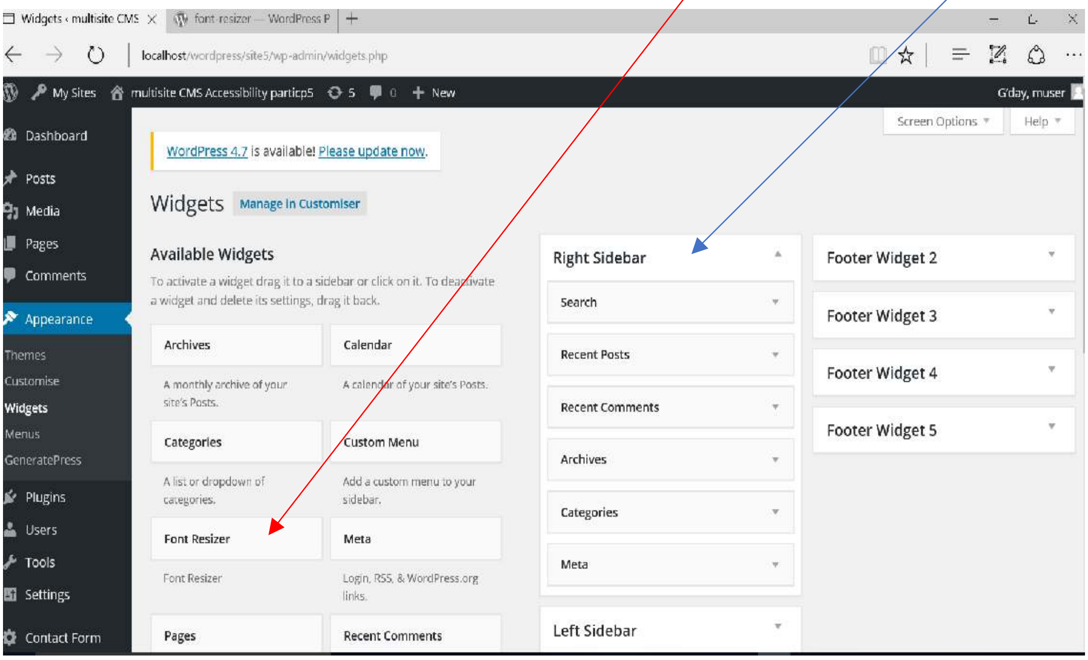


From Dashboard, click on Contact Form and copy the short code and paste it in the desired page (Ask us page) in the text editor.



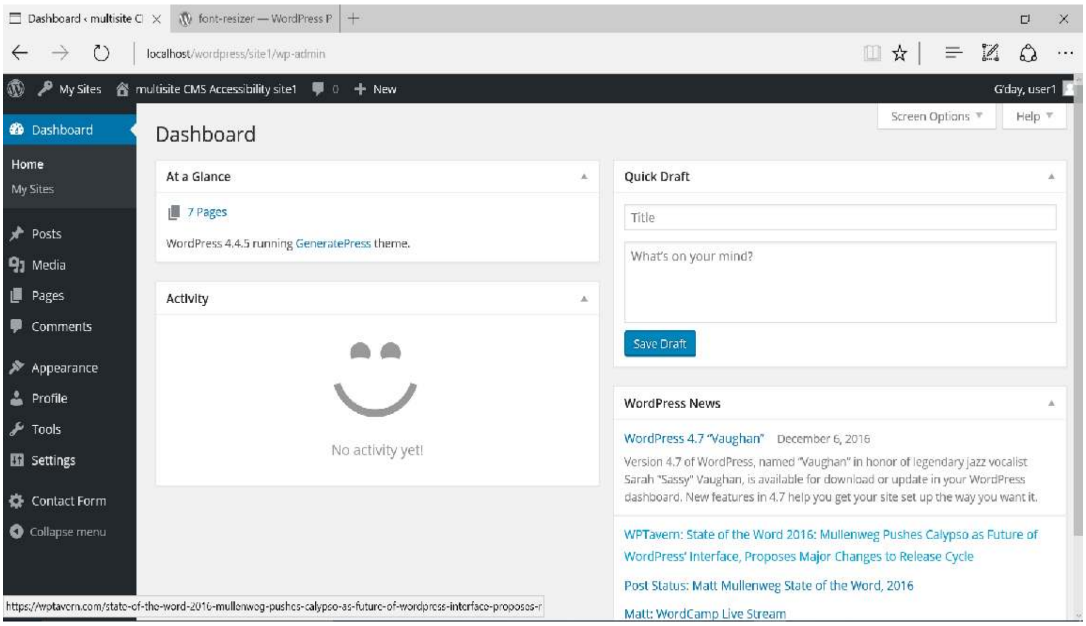
Add Font resizer for the website

From the Dashboard, click on Appearance>Widgets>Drag Font resizer to the Right Sidebar.



View the Website

Click on My Sites, then click on Site name>Visit site

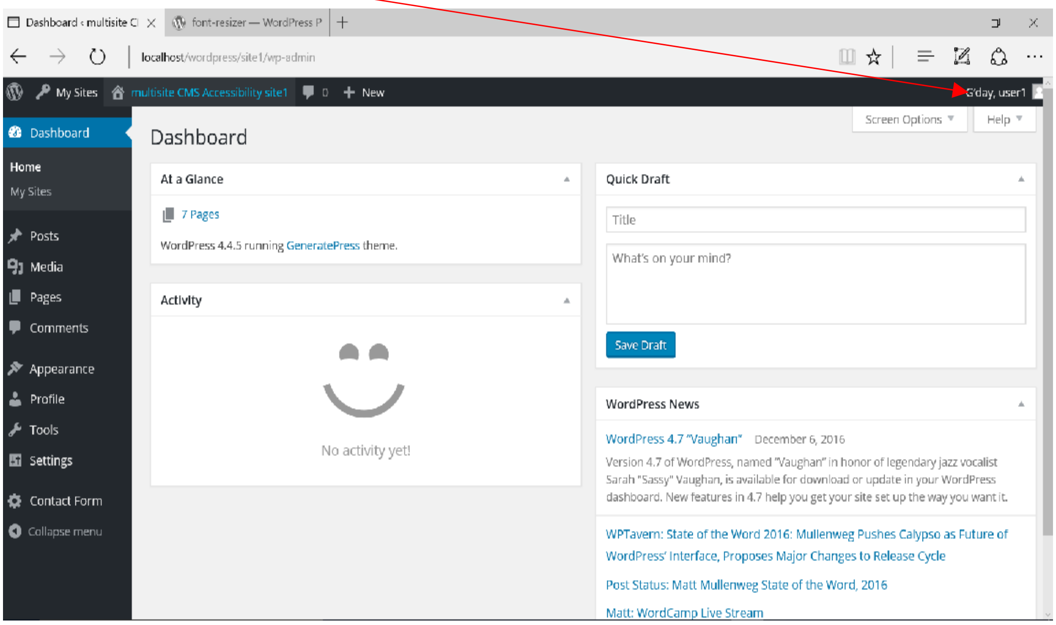


Go back to the dashboard

Click on My Sites> Site name>Dashboard.

Exit the site

Click on the username on the top right side of the screen then click on Logout.



Web pages Content

Theme used: Responsive

=========

Home Page

=========

Text

The Web

“The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect”.

Tim Berners-Lee, Inventor of the World Wide Web

Pictures

(On desktop Pictures folder) - Picture 1, Picture 2, Picture 3, Picture 4

Web Content Systems Management Page

===============================

Picture (On desktop Pictures folder)—Picture 5

Text

Abstract

Web Content Management Systems are increasingly used worldwide and yet their management interface accessibility remains an issue. Even though organisations and governments established guidelines and laws to enforce and make web content accessible to all, especially people with special needs, the accessibility of these systems remains ambiguous.

The purpose of this research is to investigate the accessibility of the administrative and management interfaces of Web Content Management Systems by people with special needs, and to test the assumption that management interfaces are problematic for these users. The study will use three of the most popular Content Management

Systems (WordPress, Drupal and Joomla) and three complementary assessment methods (Automated testing, Manual expert and User testing) to provide data that will be used to compare, analyse and interpret the results as to whether or not users with special needs can access the management interfaces of Web Content Management Systems.

Chapter 1—Introduction

Web accessibility, assistive technologies, content management, web CMS, web CMS accessibility and management interfaces are the main focus for this literature review. The subtopics outline different features of accessibility and web CMSs that are relevant to this study. The chapter will discuss the broad concepts of web accessibility before progressively narrow the research focus down to the level of web CMS accessibility.

1.1—The background to the study

Since its creation, the WWW has evolved to provide better tools, systems, interaction and accessibility for organisations, communities and individuals, despite their gender, ethnicity and disabilities. The founder of the WWW, Tim Berners-Lee, states that "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect." (Henry & McGee, 2013). To empower web accessibility by the growing number of users, especially those with special needs, organisations and countries have developed laws and policies, enabling all users to have equal access and use of websites. Indeed, the 2006 United Nations convention on the rights of people with disabilities consolidates the rights for people with disabilities to gain access the Web and other communication technologies.

1.2—The purpose of the study

The purpose of this study is to investigate whether the accessibility features of web CMSs are embedded in all aspects of the system or are mostly limited to general user interfaces. Preliminary research show that most studies focus on developing web CMSs and enhancing features of web CMSs, responding to users with special needs, instead of their peers who manage the websites through management (administrative) interfaces. In this context, this research aims to perform a comparative analysis, based on popular

Web CMSs in terms of accessibility compliance, from the perspective of sites users and site administrators. The results will be used to test the assumption that web CMS tools do not appear to cater to special need users in term of management interfaces.

Chapter 2—Literature Review

Web accessibility, assistive technologies, content management, web CMS, web CMS accessibility and management interfaces are the main focus for this literature review. The subtopics outline different features of accessibility and web CMSs that are relevant to this study. The chapter will discuss the broad concepts of web accessibility before progressively narrow the research focus down to the level of web CMS accessibility:

- Assistive technologies
- Content management
- Web CMS
- Web CMS accessibility
- Management interfaces

Chapter 3—Research Results

This chapter outlines the results derived from three types of testing methods used for the purpose of the current research. These methods, which are automated testing, manual expert and user testing, offer a set of results presented consecutively in the first, second and third sections of this chapter.

Table 3.1: Plug-in manipulation per system per error types

	WordPress		Joomla		Drupal	
	Add Plug-in	Delete Plug-in	Add Plug-in	Delete Plug-in	Add Plug-in	Delete Plug-in
AA: 1.4.3						
AAA. 1.4.6—Colour problem	9	43	213	27	37	38
AA; 1.4.4—Text size problem	93	45	498	201	4	5
AAA: 1.4.6—Colour problem	64	40	34	0	19	14

Total	196	128	745	228	60	57

Accessibility Links Page

==================

Text:

*Assistive technologies

*WCAG 2.0

Accessibility Video Page

==================

Text

------

look for a Closed caption videos for each of the following subjects:

Web accessibility: What does it all mean?

(Add a video here)

What is accessibility?

(Add a video here)

Ask a Question Page

===============

Form used: Contact Form 7

Text

Ask a Question

Ask any question and we will get back to you within two working days.

Contact Us Page

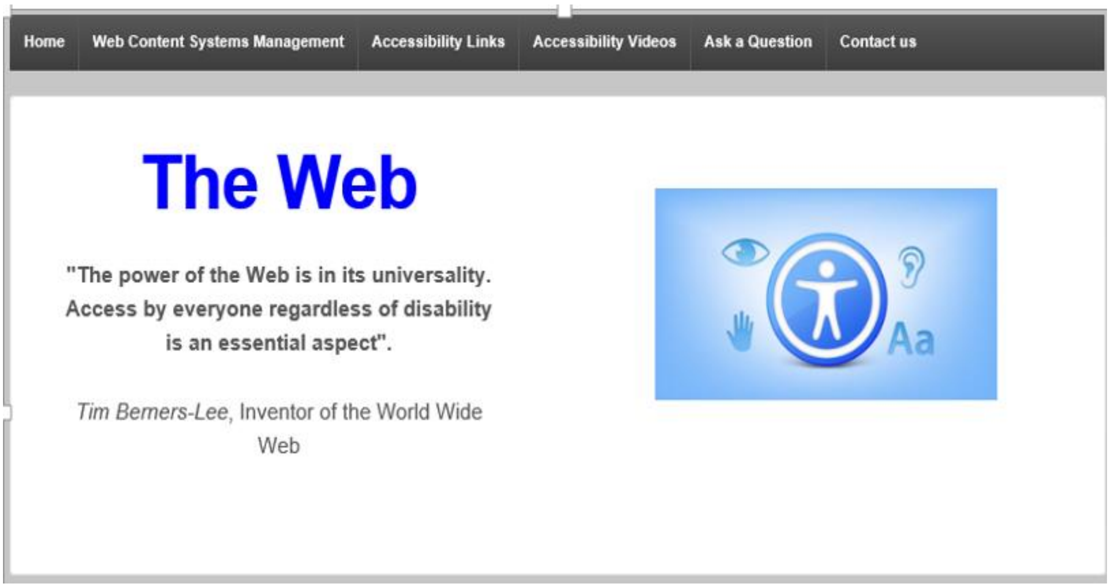
============

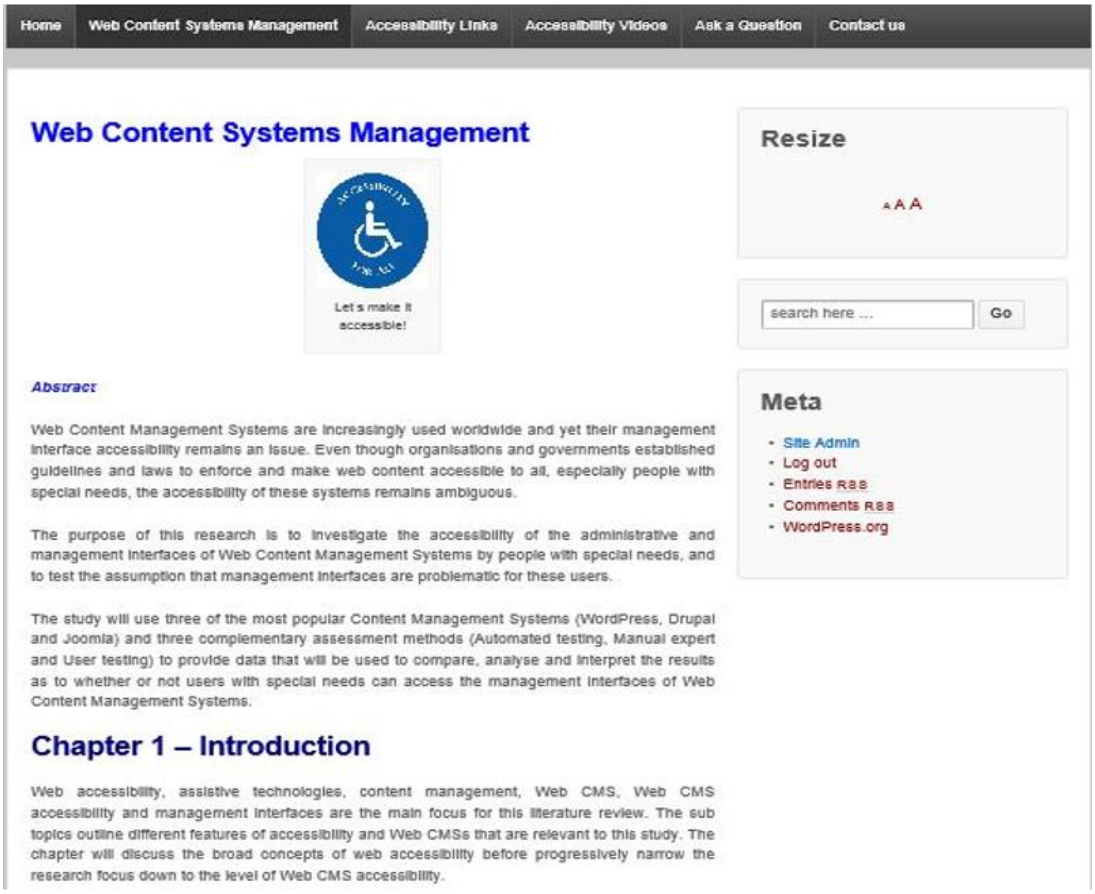
Text

Contact us
Phone: (61) (08) 9328-8764
Email: fdiaz2001@hotmail.com
Address: Edith Cowan University, Mount Lawley Campus
2, Bradford St
WA 6050

Source: Diaz, A.F. (2014). Management Interface Accessibility in Web Content Management System—Thesis of Bachelor of Computer Science (Honours)—ECU

Exemplar Output





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- Web CMS
- Web CMS accessibility
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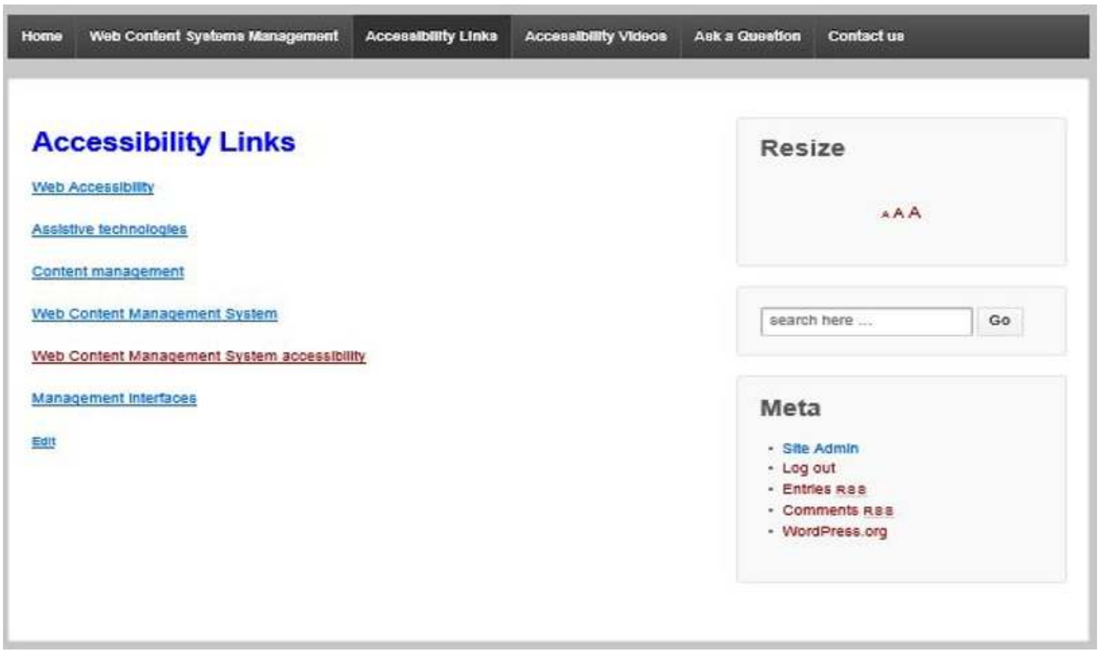
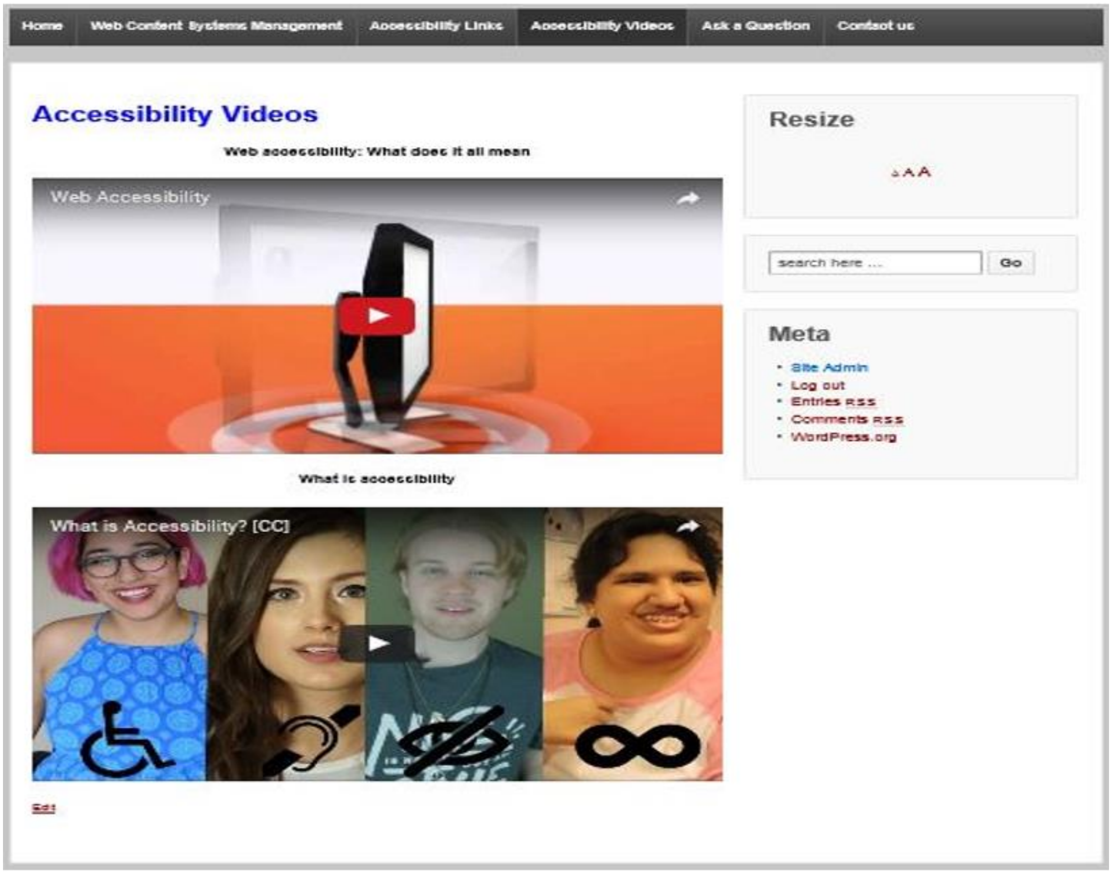
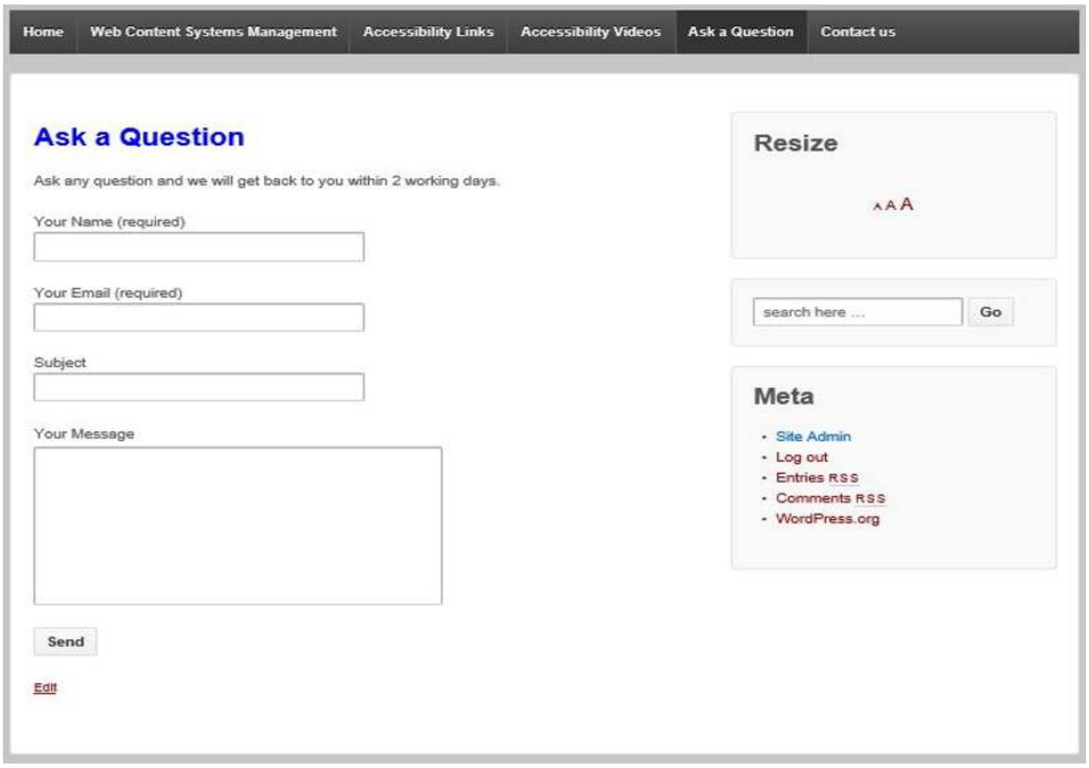
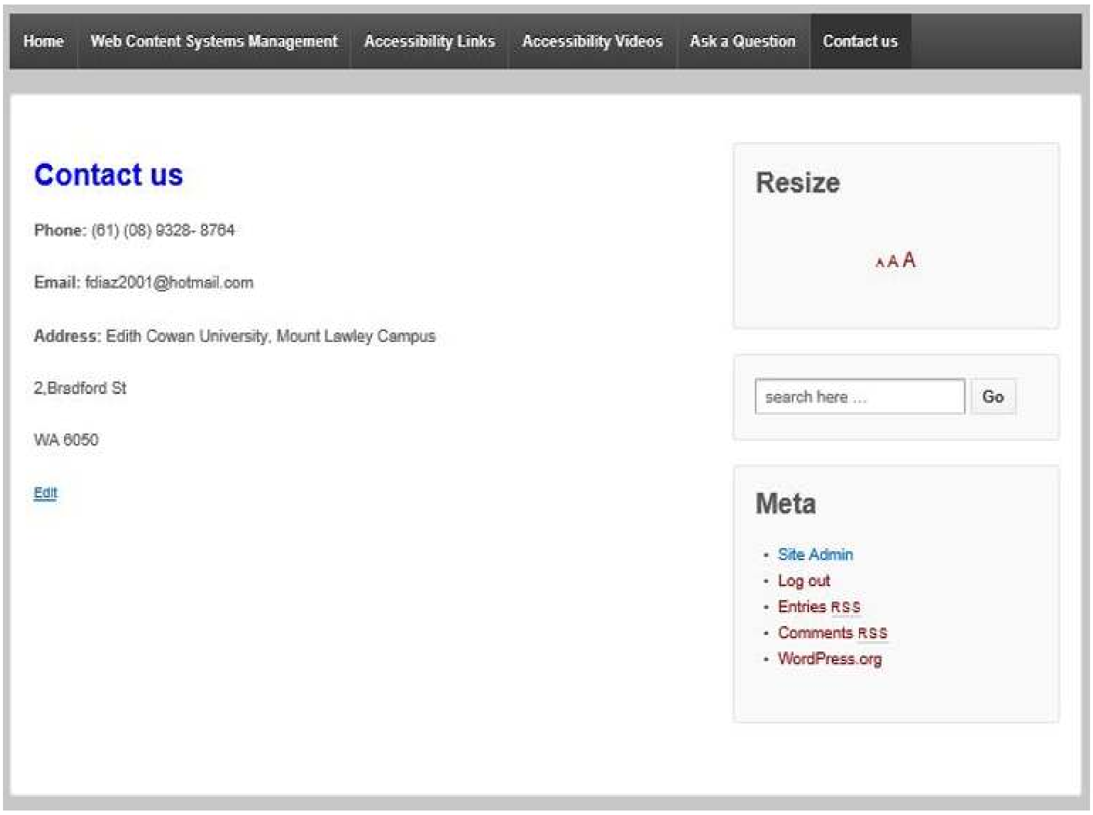
	Add Plugin	Delete Plugin	Add Plugin	Delete Plugin	Add Plugin	Delete Plugin
AA: 1.4.3, AAA:1.4.6 – Colour Problem	39	43	213	27	37	38
AA: 1.4.4 – Text Size Problem	93	45	498	201	4	5
AAA: 1.4.6 – Colour Problem	64	40	34	0	19	14
Total	**196**	**128**	**745**	**228**	**60**	**57**

Edit


Home
Web Content Systems Management
Accessibility Links
Accessibility Videos
Ask a Question
Contact us
Accessibility Links
Web Accessibility
Assistive technologies
Content management
Web Content Management System
Web Content Management System accessibility
Management interfaces
Edit
Resize
A A A
search here ...
Go
Meta
Site Admin
Log out
Entries RSS
Comments RSS
WordPress.org


Home
Web Content Systems Management
Accessibility Links
Accessibility Videos
Ask a Question
Contact us
Accessibility Videos
Web accessibility: What does it all mean
Web Accessibility
What is accessibility
What is Accessibility? [CC]
Edit
Resize
A A A
search here ...
Go
Meta
Site Admin
Log out
Entries RSS
Comments RSS
WordPress.org


Home
Web Content Systems Management
Accessibility Links
Accessibility Videos
Ask a Question
Contact us
Ask a Question
Ask any question and we will get back to you within 2 working days.
Your Name (required)
Your Email (required)
Subject
Your Message
Send
Edit
Resize
A A A
search here ...
Go
Meta
Site Admin
Log out
Entries RSS
Comments RSS
WordPress.org


Home
Web Content Systems Management
Accessibility Links
Accessibility Videos
Ask a Question
Contact us
Contact us
Phone: (61) (08) 9328- 8764
Email: fdiaz2001@hotmail.com
Address: Edith Cowan University, Mount Lawley Campus
2,Bradford St
WA 6050
Edit
Resize
A A A
search here ...
Go
Meta
Site Admin
Log out
Entries RSS
Comments RSS
WordPress.org

APPENDIX B: AWARENESS SESSION PRESENTATION

Awareness Session Presentation

Note: ALL pictures in the slides are from Google.com

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The Web: A brief history

The World Wide Web (WWW): was invented by Tim Berners-Lee in 1989.

- The idea of the web date back to as early as 1950's and even earlier(1946: short story written by Murray Leinster describing information network and its availability to everyone's home).
- 40 years after Tim Berners-Lee worked on a project called 'Enquire' in which he experimented with hypertext that utilised hyperlinks to link pages within the system.
- Berners-Lee developed the three components of the Web: HTTP, HTML and the world first web browser (WWW).

3

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World Wide Web Consortium "W3C"

An international community led by Tim Berners-Lee

The community's mission is:

- to ensure the growth of the Web
- to lead the Web to its full potential
- To develop the Web Standards

4

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Web Standards

W3C developed standards (guidelines) to support and enhance Web accessibility concerns and make the Web accessible for all users.

- Web Content Accessibility Guidelines **(WCAG):** provide requirements for text, images, multimedia, and other content to allow accessible content.
- Authoring Tools Accessibility Guidelines **(ATAG):** provide requirements for editors and content management systems to make them accessible and support authors to create accessible content.
- User Agent Accessibility Guidelines **(UAAG):** provide requirement for web browsers and media players

5

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Internet Users

Number of internet users worldwide from 2005 to 2016 by region (in millions)

	Asia	Europe	North America	Latin America/Caribbean	Africa	Middle East	Oceania/ australia
2009	764.4	425.8	259.6	186.9	86.2	58.3	21.1
2010	826.1	475.1	266.2	204.7	110.9	63.24	213
2011	1,016.8	500.72	273.07	235.82	139.88	77.02	23.93
2012	1,076.63	518.51	273.79	234.92	167.34	90	24.29
2013	1,265.14	566.26	300.29	302.01	240.15	103.83	24.8
2015	1,563.21	604.12	313.86	333.12	313.26	115.82	27.1
2016	1792.16	614.98	320.07	384.75	339.28	132.59	27.54

Source: http://www.statista.com/statistics/273018/number-of-internet-users-worldwide

6

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Disability

"A disability is any condition that restricts a person's mental, sensory or mobility functions. It may be caused by accident, trauma, genetics or disease. A disability may be temporary or permanent, total or partial, lifelong or acquired, visible or invisible" (www.and.org.au, n.d.).

Type of Disability

- Physical
- Mental
- Behavioural
- Intellectual

7

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Some Statistics

❑ Worldwide

1 billion (15%) experience some type of disability (worldbank.org, 2016).

❑ In Australia

- In 2014, 6.8 millions (40%) of Australians , aged 18 and plus have some disability or long-term health condition (humanrights.gov.au,2014).
- 43% of people over 55 years have one or more disabilities (Australian network on Disability, 2012).
- 2.2 million Australians of working age (15 – 64 years) have disability (Australian network on Disability, 2012).

8

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Assistive Technologies

Assistive technology refers to any software or hardware specifically designed to support people with disabilities in carrying out daily activities (Baguma & Lubega, 2008).

There is a number of assistive technologies products (to site only few):

- screen reader
-Screen magnifier
- Alternative keyboard
- Electronic pointing devices
- Text-to-Speech (TTS) or speech synthesizers

10

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Web Content Management Systems

Web CMSs are software systems used by organisations to assist with web content management by non-expert users.

- Web CMS environments come in many forms, such as blogging, document management, process management, learning management, etc.
- Their levels of native accessibility are recurring issues for the those used in educational contexts, such as Moodle, Atutor and Sakai.
- The most widely used general purpose, open-source Web CMSs are Drupal, WordPress and Joomla.

11

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What makes a Web Accessible

- Selection of appropriate tool that consider the accessibility.
- Structure the content by using HTML.
- Use Accessible Rich Internet Applications to ensure the accessibility of the site structure.
- Ensure that the Web content updates dynamically (i.e. without a page refresh).

12

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Thank you

Awareness training session presentation

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Presentation For Training Purpose

13

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Hypertext Markup Language (HTML)

HTML is the language of the Web

- Web pages, are text files, written in Hypertext Markup Language or HTML.
- A markup language is used to describe the contact and format of documents.
- HTML describes the format of Web pages through the use of tags.
- Almost all of the Web Content Management Systems encompass a text editor from which a user can create Web pages by using a HTML.
- The appearance of the content is controlled by the HTML tags (HTML codes)
  - * tag: name of the HTML tag (e.g.)
  - * attributes: proprieties of the tag (e.g. <tag attribute>
  - * document content: the actual content that appears in the Wen page.

14

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Some HTML codes

- **Create headings**

  <h1>Example</h1> (supports 6 levels from the largest h1 to the smallest h6). The output: **Example**

- **Entering Paragraph**

  <p>This is Example 1</p> The Output: **Example 1**
  <p>This is Example 2</p> **Example 2**

- **Entering an unordered list**

  List 1 The output: . **List 1**
  List 2 . **List 2**
  List 3 . **List 3**

- **Inserting horizontal line**

  <hr> The output:

15

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Some HTML codes (continued….)

- **Inserting an image with an alternative text (ALT) attribute**

```
<img src="xxx.gif" alt="testing">
```

- **Inserting an embed video**

```
<iframe width="xx" height="xx5" src="https://www.youtube.com/embed/code">
</iframe>
```

- **Add Link**

```
<a href="url">link text</a>
```

- **Set color, font and size of a text**

```
<p style="color:red">This is a test.</p>
<p style="font-family:verdana">This is a test.</p>
<p style="font-size:30px">This is a test.</p>
```

Output: This is a test.
Output: This is a test.
Output: This is a test.

16

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Some HTML codes (continued….)

- **Define a table**

```
<table style="width:n%">
   <tr>
      <th>xxxx</th>
   </tr>
   <tr>
      <td>xx</td>
   </tr>
</table>
```

For more information visit:
http://www.w3schools.com/

17

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Headings– things to consider

- Importance of the headings to the Website content.
- What headings can do to the large sections.
- What is the headings benefits for users of screen reader.
- In HTML, headings go from 1 to 6; Which one is the best for page title.
- Heading sequence (do not skip from h1 to h5).

18

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Text Colour- things to consider

- Why contrast between text and background is important.
- Does the use of the colour present any reading problem, especially for colour blind users?
- What is the minimum contrast ratio between the text and the background.

19

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Text resize- things to consider

- People with visual impairments need to resize the text without loosing any content or function.
- What should be done if the browser does not allow the resizing function?
- Which resizing percentage to allow in your website?
- What will happen if he image of text and captions are allowed for resizing?

20

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Tables- things to consider

- What is the structure of an accessible content of a table?
- Which sizing is appropriate for a table?
- How the screen reader will read the table?
- Why the structure of the table is important?

21

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Image - things to consider

- How people with cognitive disability will understand the Website?
- Does the image needs to have a descriptive alternative text?
- What information the text alternative provide; complementary, Additive or same information?

22

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Video- things to consider

- which videos are most required for people who are deaf/hard hearing or for non-native speaker?
- What makes a video visually accessible in a synchronised media presentation for people who are blind or visually impaired?

23

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Hyperlinks - things to consider

- Does the link pop up a new window (why is a that a problem).
- Does the link need a more descriptive title, or is the link in a sentence and its purpose is obvious? (what does this mean).
- Does the link contain enough information – i.e avoid 'click here'.

24

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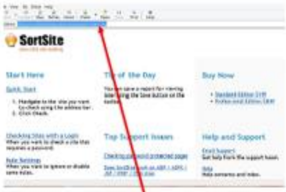
Check for Accessibility with SortSite

- Click on
- It opens a window



- Copy the URL of your site here followed by enter
- Click on Check in the tool bar

25

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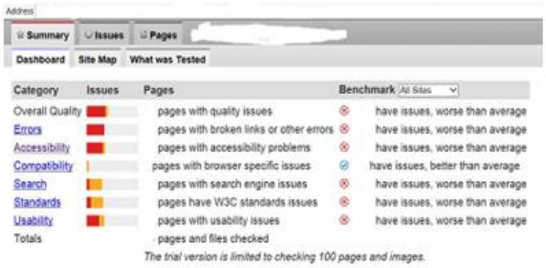
School of Science

Check for Accessibility with SortSite (continued…)

- The output will be similar to the following



26

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School of Science

Check for Accessibility with SortSite (continued…)

- When you click on accessibility it will show similar screen from where you can check for the accessibility issues.

- correct issues by visiting:

http://www.w3.org/TR/WCAG20/http://www.w3.org/TR/WCAG20/

27

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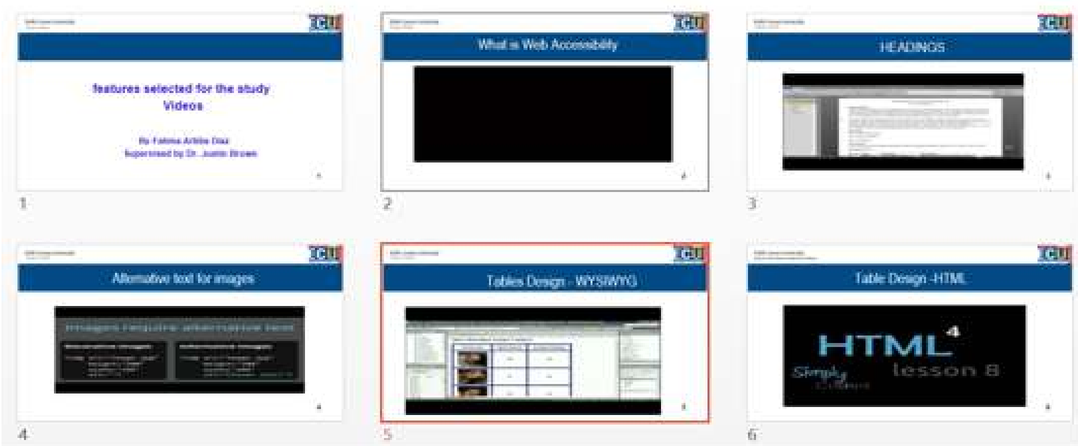
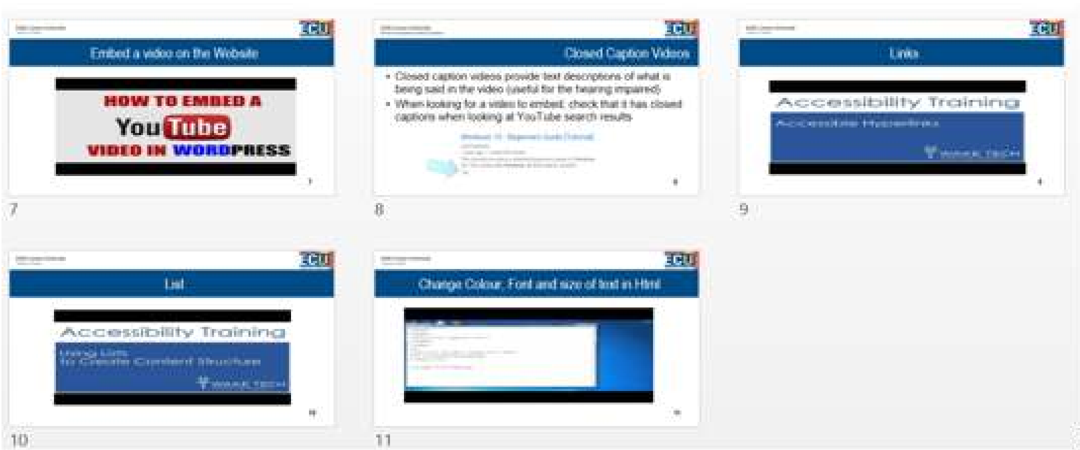
School of Science

Thank you

APPENDIX C: SCREENSHOTS OF YOUTUBE VIDEOS

YouTube Videos for the Accessibility Awareness Group





APPENDIX D: COMMUNICATION DOCUMENTS

Ethics Approval

Dear Fatima

Project Number: [redacted]

Project Name: Impact of Authoring Tools Standards and Training on Web Content Management Systems Accessibility: A Comparative Study

Student Number: [redacted]

The ECU Human Research Ethics Committee (HREC) has reviewed your application and has granted ethics approval for your research project. In granting approval, the HREC has determined that the research project meets the requirements of the National Statement on Ethical Conduct in Human Research.

The approval period is from 1 December 2015 to 20 October 2017.

The Research Assessments Team has been informed and they will issue formal notification of approval. Please note that the submission and approval of your research proposal is a separate process to obtaining ethics approval and that no recruitment of participants and/or data collection can commence until formal notification of both ethics approval and approval of your research proposal has been received.

All research projects are approved subject to general conditions of approval. Please see the attached document for details of these conditions, which include monitoring requirements, changes to the project and extension of ethics approval.

Please feel free to contact me if you require any further information.

Kind regards

Rowe

Recruitment Flyer

This is an invitation to participate in a....

Web Technology Study

My name is Fatima Diaz and I am conducting a PhD in Computer Science, examining the usability of Web Content Management Systems.

I am seeking to recruit participants who are 18 years old or over who have experience using web technologies such as social media, online learning systems or wiki's. The aim of this study is to have participants spend half a day performing some web content authoring activities using modern web technologies and to examine the usability of these tools.

As well as contributing to my research, you will also learn some web development and technology skills which you may find useful for future study and work situations.

Participants will also be in the running to win a $100 iTunes or Googleplay voucher.

For a full research information and recruitment letter please contact me at;

Fatima Artiba Diaz
[redacted]
PhD candidate

If you require any further details regarding this research, its aims or how it is to be conducted, please feel from to email me, or contact my Principal Research Supervisor;

Dr Justin Brown
[redacted]

Thank you for your consideration

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:
Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

Approval by the Human Research Ethics Committee
This project has been approved by the ECU Human Research Ethics Committee.

Recruitment and Information Letter

Dear Sir/Madam

My name is Fatima Artiba Diaz and I am a PhD candidate from the School of Science at Edith Cowan University (ECU). I am inviting you to voluntary participate in my research study titled the “Web Content Management System and Accessibility Awareness: A Comparative Study of Novice Users”.

The study aims to explore to what level the use of accessible Web Content Management System and novice users’ training impacted accessibility outcomes.

If you are 18 years of age or older and agree to participate in this research, you will be asked to develop a small website by completing tasks using a modern Web Content Management System (over the period of about four hours). Your usage of the Web Content Management System with be screen-captured, though you yourself will not be recorded. As part of the same session you will be asked to complete some small online tests and complete an online survey regarding your experiences with using the Web Content Management System.

As well as contributing to my research, the benefit to you will be gaining some experience and knowledge in the use of a modern Web Content Management Systems, systems that are used in small and large organisations worldwide. All participants who complete all aspects of the research will go into the draw to win one of 10 $100 iTunes or GooglePlay vouchers.

Confidentiality is assured as results will be coded and the output will not identify the participants. Your participation is completely voluntary, and at any stage of the research you may withdraw your consent to participate. If you wish to receive a digital copy of the completed research (i.e. the doctoral thesis) please email the researcher at the completion of the data collection session.

If you agree to participate in this research please contact me at the following email address so that I can provide you with time, date and location details of the research sessions.

Fatima Artiba Diaz
[redacted]
PhD candidate
If you require any further details regarding this research, its aims or how it is to be conducted, please feel from to email me, or contact my Principal Research Supervisor; Dr Justin Brown
[redacted]

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

Approval by the Human Research Ethics Committee
This project has been approved by the ECU Human Research Ethics Committee.

Thank you for your consideration.

Regards,

Fatima Diaz

Participant Consent Form

PARTICIPANT CONSENT FORM

Study Title: Web Content Management Systems and Accessibility Awareness: A Comparative Study of Novice Users

Researchers and contact information:

Principal Researcher: Fatima Diaz

Email: [redacted]

Dr Justin Brown (Principal research supervisor)

Email: [redacted] Work: [redacted]

Statement of consent

By signing below, you are indicating that you:

- Have been provided with a copy of the Information Letter, explaining the research study
- Have read and understood the information provided
- Have been given the opportunity to ask questions and have had any questions answered to your satisfaction
- Understand that if you have any additional questions you can contact the research team
- Understand that participation in the research study will involve attending one on-campus session in which you will fill in some online test and survey forms, author some web content and that this authoring process will be screen-recorded.
- Understand that the information provided will be kept confidential, and no identify of individual participant will be disclosed
- Understand that you are free to withdraw from further participation at any time, without explanation or penalty
- Agree to participate in the project

Name____

Signature____

Date______(d)/________(m)/_________(y)

If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

Approval by the Human Research Ethics Committee

This project has been approved by the ECU Human Research Ethics Committee.

Explanation Letter

Hi xxxx

During the day, you will start with a pre-test that takes a maximum of 3 minutes followed by a presentation and explanation of what will be done during the session (material to use, documents etc.). I will record the screen by using TechSmith recorder, if you do not like to record the voice, just let me know before we start so I can switch it off. After, you will develop the website; once you finish you will do a post-test requiring 3 minutes maximum and a survey that will take 5 minutes maximum.

The location of the room is in Building 18 at Joondalup Campus (see map below), just get in the building and walk straight away on your right there is a lift, take it to level 4; There is a corridor slightly on your left walk to its end on the left side you will find the room (Room18.417 Research Laboratory 2), if you get lost just call me. If you will be late, please inform me in advance.

For any more clarification, please let me know via email or phone.

Best regards,

Fatima Diaz

PhD candidate

Phone: [redacted]

Email: [redacted]