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Evaluation of universal design web resources: usefulness and user experience

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ABSTRACT

When searching for information on Universal Design (UD) of Information Communication Technologies (ICT) on the internet, Universal Design Resource (UDR) websites have a larger pool of UD information. UDR websites aim to promote UD, accessibility, usability to all users. However, many users are having difficulty perceiving information from those websites. This paper focuses on ICT professionals' and students' perception of UDR content, as well as the usability of UDR websites. A combination of user testing, observation, and semi-structured interviews with five ICT professionals and five IT students were used to accomplishing the goal of the research. The results show that users have a positive attitude about UDRs content as a source of learning about UD of ICT. However, ICT professionals and students have faced several usability barriers in UDR websites. These barriers are due to website design, information organization, searching function, labelling, and website content. This research concludes that some adjustments are needed to make UDR websites more usable, accessible, and informative because there are several usability and content related issues. A set of recommendations for improving UDRs content and its presentation to ICT professionals and students in the context of universal design are developed.

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LIST OF ABBREVIATIONS

ATAG – Authoring Tool Accessibility Guidelines

CD-ROM – Compact Disk Read Only Memory

HCI – Human-Computer Interface

ICT - Information and Communication Technology

IT – Information Technology

NDA – National Disability Authority

NENT – National Committee for Research Ethics in Science and Technology

QRCA - Qualitative Research Consultants Association

UAAG – User Agent Accessibility Guidelines

UD - Universal Design

UDR - Universal Design Resources

USA – United State of America

UX - User Experiences

WCAG – Web Content Accessible Guidelines

1. INTRODUCTION

Information and communication technologies (ICT) are getting more sophisticated, adaptable, and personalized each day. This development constantly improves our everyday living standard and brings us a variety of new opportunities. New ICT technologies assist individuals with physical disabilities in overcoming challenges at work, in education, and at home (Choi, Yi, Law, & Jacko, 2006, p. 87). The lack of accessibility and usability in ICT solutions on the other hand has created inequality and a digital divide among users (Harder, 2017, p. 15). As a result, over the last decade, there has been an increased focus on User-Centered Design[1] and Universal Design[2] (UD) in ICT development.

UD information and knowledge are available from a variety of sources, collectively referred to as Universal Design Resources (UDRs). Many countries have made laws and guidelines, for example, Web Content Accessibility Guidelines[3] (WCAG), to promote accessible ICT solutions over the last few decades. However, standards and guidelines alone are insufficient to encourage Universal Design Practices (Choi et al., 2006; Harder, 2017; Røssvoll & Fuglerud, 2013). Taking this into account, academic and consulting communities have been working on exchange expertise and awareness about UD in the ICT field. Nowadays, many websites are providing information and technical aspects about UD, accessibility, usability to their readers. Unfortunately, users are facing a variety of usability and content-related barriers when perceiving information from the internet and UDRs in particular (Hasan & Abuelrub, 2011; Nowakowski, 2020; Thielsch & Hirschfeld, 2019). To promote UD in ICT, UDR websites and its' content should be accessible and usable to all readers.

[1] User-centered design (UCD) https://www.interaction-design.org/literature/topics/user-centered-design

[2] Universal Design http://universaldesign.ie/what-is-universal-design/

[3] Web Content Accessibility Guidelines https://www.w3.org/WAI/standards-guidelines/wcag/

Many studies have analyzed UDRs from various viewpoints, such as the usefulness of UD information, usability, and open standard guidelines(Choi et al., 2006; Chris M. Law, Jaeger, & McKay, 2010; Chris M Law, Soo YI, Choi, & Jacko, 2007; Chris M. Law, Yi, Choi, & Jacko, 2008a). Chris M. Law et al. (2010) study focused on the usability of UDRs and compared it to a user-centered solution. According to their conclusion, the UDRs contain usability barriers to target audiences. The study also highlighted that developing a UD product/website is not possible if user expectations are not taken into account throughout the development (Chris M. Law et al., 2010). Chris M. Law et al. (2008a) research explored UDRs usability from the designers' perspective. Their results reveal that designers had to struggle with usability problems in UDRs. Choi et al. (2006) study results also show usability issues faced by designers from its content. According to previous studies (Choi et al., 2006; Chris M. Law et al., 2008a), there is a lack of research on UDRs from the user's perspective. The authors also emphasized the importance of further investigation on the usability of UDRs.

This thesis focuses on ICT professional's and student's perceptions of UDR websites content. It intends to identify UDRs usefulness and user experiences in terms of usability of UDR websites. The term usefulness in this research is described by content to be informative, relevant, credible, and understandable to users. To achieve the goal of this research, four UDR websites are selected based on three selection criteria: web-based resources, google search engine, and international perspective. The qualitative research method is used, interviews and observation with ten participants are conducted.

The results obtained from a study are analyzed using qualitative content analysis techniques. Based on this, a conclusion about ICT professional's and student's perceptions of UDR content is presented. The set of recommendations for the potential improvement of UDR usability and its content usefulness is provided.

1.1 Problem statement

With the increase in focus on Universal Design in ICT, many government and public organizations have been providing web-based UD materials to their users. However, there is a lack of research on how much UDRs content is useful to the target audience, for instance, ICT professionals and IT students for learning and implementing UD in ICT. Due to usability

issues, ICT professionals and students are unable to take full advantage of learning UD in ICT from web resources.

This thesis will investigate usability barriers on UDR websites, users' experience, and their perception in the context of universal design by conducting qualitative research (qualitative interviews and observations) with ICT professionals and IT student's participation.

1.2 Research questions

This research aim is to identify and comprehend barriers in web based UDRs for ICT professionals and students. First, it is important to identify barriers that users can be experienced during the information-seeking process in UDR websites. This brings us to the first question:

> **QR1:** What are the barriers ICT professionals and students can experience with UDR websites?

The answer to the question will be found by conducting interviews and observation with ICT professionals and IT students. The findings would provide insight into what usability and content-related barriers users will face when using UDR websites. These results also assist us in gaining a deeper understanding of the usefulness of website content. The concept of usefulness, in this case, define as website content to be informative, relevant, credible, and understandable to users. This leads to a second research question which will be the part of the future practical investigation:

QR2: How useful is the content of Universal Design Resources to ICT professionals and students for learning UD of ICT?

The results will help us in gaining a deeper understanding of the information's usefulness and users' perception of UDR content. Finally, a set of guidelines will be given for the potential improvement of UDR websites and their contents.

1.3 Outlines of the thesis

The present research is divided into seven-chapter. The first chapter contains the introduction, problem statement, and research questions of this research. Continue with extensive literature reviews relevant to this research is presented. It describes details on the need for UDR, as well as defining the key dimension of measuring the usability of UDR websites. Chapter 3 “Methodology” described the methodological aspects of the current research. It explains the methods and techniques used to obtain data during the research. Chapter 4 “User testing and Interviews” describe the detailed process use during data collection. Chapter 5 “Results and analysis” provides the finding of the current research. The results obtained from chapter 5 are discussed in chapter 6 with the relation to literature review findings provided in chapter 2. The discussion also includes the limitation of the current study and a set of recommendations to improve UDR sites. The final chapter emphasizes the main point and provides the thesis conclusion. It also provides the recommendation for the possible future research in web-based UD resources.

2. LITERATURE REVIEW

The following section focuses on the literature review on several topics that are related to this thesis. The section starts with an explanation of the UDR need for ICT professionals and students. Continues with universal design resources, website usefulness, and user experience are reviewed. Then, based on previous studies, the key dimension measuring website usability is defined. Finally, a summary of this chapter is presented.

2.1 UDR need for ICT Professionals and students

The concept of Universal Design (UD) is getting popular, and national and international UD legislation, accessibility standards, and guidelines have developed to promote UD practice in ICT (Choi et al., 2006; Røssvoll & Fuglerud, 2013; Schulz, Fuglerud, Arfwedson, & Busch, 2014). Several scholars, on the other hand, have found that standards and guidelines alone are insufficient to guarantee a universal design of ICT solution (Choi et al., 2006; Harder, 2017; Røssvoll & Fuglerud, 2013; Schulz et al., 2014).

UD resources provide valuable information on the accessibility and usability of ICT solutions. Despite this, ICT professionals and students have a lack of knowledge in these fields. According to the result of Helvacioglu and Karamanoglu (2012) study, higher education students are unaware of the UD concept. They said that without educating UD knowledge among students in higher education, they are unaware of the design aspect of specific user groups. A similar view was given by Naoe Tatara and Giannoumis in their study. They said that a UD-oriented mindset can be developed among younger people from higher education to promote a more democratic and sustainable society (Naoe Tatara & Giannoumis, 2017)

A cross-sector survey of 613 web development project participants from government industry and academics in 27 Brazilian states found that ICT professionals lacked knowledge and experience on UD (Freire, Russo, & Fortes, 2008). Their findings also support the need to devote more resources to train developers in assistive technologies and considering their design from a disabled perspective.

Power et al. (2012) observed similar findings in their research. Their finding points out the problem in creating accessible websites is the lack of knowledge with developers. They said

that designers and developers are faced difficulties in implementing WCAG Success Criteria during the development process and even though the Success Criteria was implemented, it failed to solve the user problems. Chris M. Law et al. (2008a) study result shows that correctly designed UDRs are crucial for passing UD knowledge and, ultimately, encouraging UD practices.

Many researchers provide their views on promoting UD information to ICT professionals and students. Salmen (2001) said that the effective implementation of the standard guideline is based on training and availability of resources in suitable formates for those who create and implement the design solution. Putnam et al. (2012) said that the proper knowledge about the accessibility among the professionals relied on implications from the quality of the academic program related to HCI and UX which advocate for inclusive design. According to Persson et al. (2015), the credibility and seriousness of UD practices among ICT professionals can be improved by clearly defining UD information, open standards, and guidelines.

Previous research work shows a gap in UD knowledge and awareness among ICT professionals and students. This gap can be fulfilled through education and providing UD resources in a suitable format to ICT professionals and students.

2.2 Universal Design Resources

As defined in the previous chapter, information about UD can be obtained from various sources which are collectively known as Universal Design Resources. UDRs provide national and international open standards, guidelines, legislation, collections of design criteria, web-based educational pages, written books, CD-ROM-based content collection, and case studies. UDR has been promoted in a variety of forms in several countries over the years.

Some research scholars and UDR creating members have been examining the quality and usefulness of accessibility and usability guidelines and standards in terms of how effectively they address the needs of their intended users. Chris M Law et al. (2007) attempted to identify how UD resources addressed the needs of designers. They looked at how UDRs can help designers with their approach to design and design psychology. They have used different techniques for evaluating UD resources such as heuristic evaluation, conduct

surveys, and interview people who have been involved in developing those resources. The study identified five unsolved problems in the creation of UD resources as,

- The guidelines are unable to define the target audience and its needs.
- Accessible and universal design terminology used in the guidelines is not described in detail.
- The guidelines are not universally accepted as standard guidelines, for example, the US has its standard guideline of accessibility (Section 508 standard and Section 255 Guidelines for ICT).
- There is no enforcement in the implementation of the guidelines. That means guidelines are only the name and document that exist, no one wants to follow them.
- The usability of the guideline is compromised.

However, their study only focuses on the perception of UD content from UD resource creation committee members. Yet, those resources are available to all users and thus there needs to further study on users' perception of UDRs content.

Chris M. Law, Yi, Choi, and Jacko (2008b) have attempted to identify the gap between user needs and UD resources. They have conducted interviews and surveys with UD resources creating committee members to identified how they include the need of designers from various forms of UD resources. Their finding shows three of UD research creating team unable to satisfied designer need through systematic processes. Their research finding also revealed that two of UD resources did not clearly define the "Central idea" of accessibility/UD guidelines to their committee members (Chris M. Law et al., 2008b). The finding from their work identified the practical use of printed and web based UDR material from a designer's perspective. Although, there is still the need for research work on the usability of web based UDR to know the complete picture of users' needs and barrier they faced from current UDR websites.

Another similar study evaluates the effectiveness of four UD resources (Section 508 standard, Web accessibility guidelines, a British Standard, and Irish guidelines) among target audiences (Chris M. Law et al., 2010). Their study revealed the usability problem with universal design resources. They argue that the Section 508 standards, web accessibility

guidelines, and the British Standard on dealing with the inclusive design did not sufficiently address the need of designers in the design process (Chris M. Law et al., 2010). According to the researchers when standards and guidelines creating communities do not take into the target user need then the developer will be faced usability problem.

These are some of the research examples that evaluate the usability and perception of UDR content from UD resource creation committee member and designer perspective. Yet UDR information is perceived and interrupted by all users. Thus, user perception of UDRs needs to be evaluated with their involvement.

2.3 Website usefulness and User Experiences

In this study, website usefulness applies to the website's technical dimensions which include functionality and usability. Usability refers to the appearance or ease of use of a website, while functionality refers to its content (Yeung & Lu, 1998).

Usability refers to all of the ways that users interact with computers in the world of Human-Computer Interaction (HCI) (Stone, Jarrett, Woodroffe, & Minocha, 2005). Usability in the field of HCI is interpreted and measured in a variety of ways by various scholars. For example, Nielsen (2012) uses five attributes to define usability: Learnability, efficiency, memorability, errors, and user satisfaction. This definition means that devices or products usability is defined by a set of an attribute or design goal. As cited by Nowakowski (2020), Steve Krug stated that the website's usability is determined by factors such as ease of use, helpfulness, desirability, delight, efficacy, and performance. However, international standards (ISO 9241-11, 2018) define usability in broader definition as "*Usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"* (ISO 9241-11, 2018).

Information usefulness is defined as the extent to which users perceive valuable information. It demonstrates how people perceive information to help them find more pleasure, satisfaction, and do better at work (Shin, 2017). According to Luo, Luo, and Bose (2018), information usefulness depends on two information attributes: content-related and environment-related attributes. When an individual carefully examines the quality of information, they determine its usefulness using content-related attributes. If the users rely

on basic knowledge clues to evaluate information without giving it much consideration, the environment-related attribute impacts their decision. Previous research has shown that information quality is typically a content-related attribute such as content clarity, comprehensibility, relevancy, informativeness (Muylle, Moenaert, and Despontin (2004), Thielsch and Hirschfeld (2019), Hasan and Abuelrub (2011)), whereas the environment-related attribute often involve information sources including credibility, authority, information quantity (Elling, Lentz, and De Jong (2007), Fink-Shamit and Bar-Ilan (2008), Thielsch and Hirschfeld (2019)).

The term "user experience" refers to a person's overall experience with a device or product. User experience in HCI is a broader concept, is defined and measured differently by different authors. The term "user experience" is described by an International standard as "*user's perceptions and responses that result from the use and/or anticipated use of a system, product or services*" (ISO 9241-210, 2019). User experience encompasses all facets of user interaction with the company, its services, and its products (Don Norman, 2020). Morville (2004) defined the seven criteria for measuring user experiences which include usability, findability, accessibility, usefulness, desirability, credibility, valency.

2.4 Key dimension measuring website usability

Many researchers have attempted to identify a universal framework for assessing website usability. However, there is no universally accepted set of standards for evaluating website usability. The literature is reviewed in detail to identified principal factor that suggests a successful design for websites. These factors can be considered as a mechanism for measuring the usability of UDR sites. Table 2.1. presents the web usability dimension from previous studies.

Table 2.1. *Web usability dimensions from previous studies.*

Usability attribute	**Palmer (2002)**	**Agarwal and Venkatesh (2002)**	**Yang, Linder, and Bolchini (2012)**	**Aladwani and Palvia (2002)**	**Pearson, Pearson, and Green (2007)**	**Hasan and Abuelrub (2011)**	**Rinder (2012)**
Findability					X		
Navigation	X		X	X	X		X
Interactivity	X			X			
Content	X	X	X	X		X	X
Clarity of goal				X			
Download delay / Response	X				X		
Ease of Use		X			X		X
Responsiveness	X						
Promotion		X					

Customization and personalization		X		X	X	X	
Organization			X	X		X	
Layout			X	X			X
Graphics			X				X
Search				X			X
Link				X		X	X
Color					X	X	
Text					X	X	

Many factors have their own impact on the success of the website. In this study, various usability dimensions identified in previous research work are grouped into seven major usability attributes.

- Appearance
- Organization
- Navigability
- Findability
- Labeling
- Interactivity
- Customization and personalization
- Information Content

2.4.1 Appearance

The appearance of a website creates the first impression with users whether they will stay or leave the website. The three subcategories that make up a website's design appearance are space separation, scalability, and readability.

According to Becker and Mottay (2001), design consistency refers to the concept of space division, which is defined as page components that are consistent both within and between the pages. The consistent design interface provides a common look at each page to the user, which makes the web page more efficient and comfortable. Inconsistent displays have been shown to produce more errors than consistent displays (Leavitt & Shneiderman, 2006). According to Leavitt and Shneiderman (2006), design consistency contains size, character spacing, label color, fonts, background, label location, text, and images.

The information scalability also creates a positive impression among users (Morkes & Nielsen, 1997). Users first tend to scan information that they are searching on the website. If they are unable to find any relevant content, they can quickly give up (Morkes & Nielsen, 1997). Consequently, scalability should be the first factor when designing and developing a website. According to Morkes and Nielsen (1997), the use of headings, bold text, highlighting text, bullet lists, topic sentences, captions, and table of content webpages will increase information scalability.

Another factor that affects the website's attraction is the readability of information. The reading activities are significantly influenced by textual features such as font size, font type, text color combination, alignment, paragraphs words, and letters (Bernard, Liao, & Mills, 2001; Beymer, Russell, & Orton, 2008). The use of bold text with familiar fonts, as well as colors that increase content readability.

2.4.2 Organization

Organization of information is a way of presenting information based on information categories. A clear and logical structure organizes the information in a meaningful way as it fulfills the requirement of the application, user's task, and key messages to convey (Lynch & Horton, 2016; Yang et al., 2012).

According to Leavitt and Shneiderman (2006), it is possible to organize information by putting important information at the top of the web, grouping relevant items, and making appropriate information accessible to visitors. Lynch and Horton (2016) said that hierarchical organization is a critical requirement on the web for categorizing information from the broad to the unique. The designer and developer create a website based on information categories after identifying a logical set of priorities and relationships in the content.

2.4.3 Navigability

Several previous studies have established navigability as one of the most critical considerations for web usability (Yang et al. (2012), Aladwani and Palvia (2002), Pearson et al. (2007)). Yang et al. (2012) said that good navigation helps the user in finding the information they need and can move from one page to another easily. Yang et al. (2012) analytical composition of design result showed that navigation provides a road map to the user and helps in finding information.

According to Nguyen (2010), the navigability of a website depends on links, consistency, flexibility. With the help of a well-designed framework, users able to know their current/visited location and can easily find out the location they want to go on web pages.

2.4.4 Findability

Rosenfeld and Morville (2002) and Pearson et al. (2007) research work identified that information findability is one of the critical success factors for web usability. According to Pearson et al. (2007), findability is important for web usability as it makes information available to all users.

According to Rosenfeld and Morville (2002), users always want a search feature to be available when searching for information on a website. Users are not always able to browse via the website system due to time limitations, a lack of patience, and many other reasons (Rosenfeld & Morville, 2002). When a webpage is large and contains a lot of content, the search function will help users in finding information.

2.4.5 Labeling

Labeling is a way of presenting concepts and content information. Rosenfeld and Morville (2002), state that the label link between the audience and website content providers to communicate information effectively. Thus, labeling is considered an important factor to convey website content to the users.

As stated by Morkes and Nielsen (1997), rather than reading word by word, most users prefer to scan information. Therefore, a suitable heading is very important to find and read the content to the users. According to Morkes and Nielsen (1997), unique and descriptive headings are very supportive of the user in finding and reading website content.

2.4.6 Interactivity

The interactivity of the website is a way of establishing interactions with users and website content. According to Palmer (2002), interactivity is one of the key elements for a successful website design. He also suggested that interactive websites enable site visitors to communicate with one another. User interest is boosted by feedback, frequently asked questions, and rating schemes, both of which help to improve the website's content (Ironistic, 2021).

2.4.7 Customization/Personalization

Customization and personalization allow the user to dynamically fitting the site as their need (Agarwal & Venkatesh, 2002; Palmer, 2002), which are important factors in the website's success. In other words, it enables users to keep track of the amount of information they see on websites. According to Agarwal and Venkatesh (2002), personalization is needed for websites to maintain a partnership with users. According to the result of Liang, Lai, and Ku (2006), users would be more satisfied if they used an immersive website that could be customized according to their preferences. However, too much personalization will result in lower user satisfaction and information overload (Liang et al., 2006).

2.4.8 Website Content

Several past research work found that the website content quality is measured based on user perception on web contents is systematically related to user reactions, for example, perceived ease of use and usefulness (Ahn, Ryu, & Han, 2007; H. Kim & Niehm, 2009), user attitude and satisfaction(S. Kim & Stoel, 2004; Palmer, 2002), trust (De Wulf, Schillewaert, Muylle, & Rangarajan, 2006), informativeness and security(Lin, 2007), website success, commitment and loyalty(De Wulf et al., 2006; Salehi, Abdollahbeigi, Langroudi, & Salehi, 2012), perceive web quality (Aladwani & Palvia, 2002). The findings of previous studies demonstrate the importance of user comprehension of web content and its effect on user behavior. Table 2.2. shows various dimensions used in past work to evaluate website content quality and its suitability for an individual.

Table 2.2. *Content quality dimensions from previous studies.*

Content Quality Dimensions	**Muylle et al. (2004)**	**Elling et al. (2007)**	**Thielsch and Hirschfeld (2019)**	**Hasan and Abuelrub (2011)**	**Moustakis, Litos, Dalivigas, and Tsironis (2004)**	**Fink-Shamit and Bar-Ilan (2008)**
Comprehensiveness	X	X				
Relevancy	X	X		X	X	X
Comprehensibility	X	X				
Accuracy	X			X		X
Ease of Use	X					

Clarity			X			
Likeability			X			
Informativeness			X		X	
Credibility			X		X	X
Authority				X		X
Multilanguage/culture				X		X
Timely				X	X	
presentation				X	X	
Objective				X		X

What factors have a significant impact on how people perceive web content is still a hot topic of debate. This can vary depending on the user's preferences, the target audience, and the website's goal. Many attributes have their influence on creating quality information on UDR websites. In this literature review, these attributes are grouped into four mains categorize.

1. Content clarity
2. Credibility
3. Relevance
4. Content informativeness

Clarity/Comprehensibility

Content clarity is most important for users to visit and re-visit websites. The content clarity assesses how web contents capture the user's attention by presenting it clearly and concisely, and the comprehensibility of language used (Thielsch & Hirschfeld, 2019). Users do not often visit the site when information present on the site is not clear or comprehensible to them. So, clarity is considered as one of the important factors for website content quality (Aladwani & Palvia, 2002; Marsico & Levialdi, 2004; Thielsch & Hirschfeld, 2019).

As stated by Leavitt and Shneiderman (2006), writing clear content on the website need to include the use of familiar words, avoiding the use of jargon, a minimum number of words in a sentence and sentence in a paragraph, use of mixed upper and lowercase letters, limit prose text on the navigation page, make a first descriptive sentence. The huge information on a single page challenged the user's brain to accommodate all of it, causing them to get overwhelmed and abandon the task (Thomas, 2020). The following Table 2.3. provides guidelines for writing content length on the website.

Table 2.3. *Content-length in the website content (Design, 2011, p. 15).*

Type of content	**Word count**
Heading	8 words
Sentences	20 words
Opening paragraph	30 words
Other paragraphs	60 words (2 – 3 sentences)
Web page	600 words

Creditability

The creditability of content is the extent to which the content is trustworthy, reliable, and authentic for given websites. These factors all affect the website content attraction. According to Fink-Shamit and Bar-Ilan (2008), the creditability of internet information depends on the credibility of the content and the credibility of the site. They define the credibility of content based on authority attributes (i.e., author, completeness, scope, accuracy, type of reference, writing style, currency, prior acquaintance with the site, source, quotes). On the other hand, the creditability of the website depends on the overall design and appearance of the site. The main attributes of credibility of the website are the design and language (Fink-Shamit & Bar-Ilan, 2008).

According to the result of Sbaffi and Rowley (2017) study, website design, simple interface, interactive functionality, and authority have a positive impact on trust and credibility among users. In terms of content, the author's authority, ease of use, and content all contribute to the creation of trust among users (Sbaffi & Rowley, 2017).

Relevance

Web content relevance refers to how well website information meets the need of users. When looking for information, we first investigate the most relevant information that we are searching for on the website. Before visiting the website, we assess the relevance of the search result (Fink-Shamit & Bar-Ilan, 2008). According to Fink-Shamit and Bar-Ilan (2008), the importance of content relevance is determined by rating, language, title, question relationship, and snippet attributes. Their study results show 18% of their participants were use language as one of the attributes in searching relevant information whereas, 32 % and 30 % of participants mentioned that snipping and ranking are the most frequently used attributes for looking at relevant information.

Content informativeness

The sum of useful and relevant information on a website is determined by its informativeness (Thielsch & Hirschfeld, 2019), which is a key attribute for website success. The user's attitude toward the website can be positively influenced by the website's

informative content. According to Kang and Kim (2006), informativeness and entertainment are important factors of website quality that impress users to visit the websites. Their research results show that informative or useful website content on the website has a positive impact among users to revisit the website regardless of their interest level.

2.5 Summary

In summary, after carefully investigating past research work related to Universal Design Resources, it can be concluded that the issue of usability and user experience on UDRs were not sufficiently investigated. Previous works were unable to investigate user perception of web-based UD resources rather it focusses on usability UD resources and design psychology of UD resource providers.

Many websites have been publishing UD information to their readers. However, there is a lack of study on how a website is useful to ICT people and what barrier they face during the information retrieving process from UDR websites. All these issues will be addressed in this research, to improve the usability and accessibility of UDR sites.

The current research practices on the need of UDR to ICT people, defining the term universal design resources, usability, information usefulness, and user experience were explained. The detailed literature review has provided a different dimension on measuring usability and information usefulness. There are differing perspectives on which considerations should be weighed when determining web usability and information usefulness; there is no universal definition, and this literature only identifies those that have a significant effect on usability and users' understanding of web content.

The usability and usefulness of web-based UD resources can be assessed using these criteria. Since customization factor will be omitted from the assessment process because it is not available on UDR websites.

3. METHODOLOGY

The following section of the research provides an outline of the data collection process and techniques used in this study. The section starts with a selection of universal design resources, continues with research design, approach, and description of data collection technique. Finally, data analysis and ethical considerations are discussed.

3.1 Selection of Universal Design Resources

The selection of UDRs is based on the following factors.

- **Web-based Resources**: As the focus of the study is, UDRs usefulness and user experiences from web-based resources, so only web-based information is considered for the study. Online web content provides a better way of learning. This is because people spend a lot of time reading or engaging themselves on the internet in the present context and online services have also heavily influenced us.
- **Google search engine**: When people unaware of UD terms and concepts then they first look at the internet. As Google's search engine is popular, people would like to go to the search engine to know more detail about UD. A range of keywords is used with a different combination of terms, including digital accessibility, usability, Universal Design, form design, mobile accessibility, etc. for searching UD information.
- **International perspective**: Many UDR websites were made to promote the UD concept among the public. I decided to select UDR websites based on diverse geographic regions. This result one from Europe, one from Ireland, and two from the USA. Only the resources that are available in English are considered for this research as it is a globally accepted language.

Table 3.1. *Selected UDR websites for the study.*

ID	Resources	Region	URL
A	Centre for Excellence in Universal Design	Ireland	http://universaldesign.ie/Home/
B	University of Washington resource site	USA	https://www.washington.edu/accessibility/
C	World Wide Web Consortium	Europe	https://www.w3.org/WAI/
D	Tarleton State University resource site	USA	https://www.tarleton.edu/accessibility/

Based on three selection criteria, four UDR websites are selected for this study. Table 3.1 lists out four selected UDRs with their address. The table contains the ID that is used to defines the naming of UDR websites.

3.2 Research Design

Research design provides the logic or master plan of study that includes different activities within research such as method and technique used in research. It shows the architectural outline of research where all major parts -the samples or groups, measures, framework, or program, etc. - are worked together to address the research questions. The research design is determined by the purpose of the study (Easterby-Smith, Thorpe, & Jackson, 2012).

The research design used in this research is exploratory, with qualitative methods. An exploratory research study, according to Saunders, Lewis, and Thornhill (2009, p. 139), is preferable when useful ways of finding out what is happening; discovering new insights; asking questions, and examining phenomena in a new way are available. For researchers, it

is beneficial to explain their interpretation of the problem (Saunders et al., 2009), in our case- interpretation of UDRs content to ICT professionals and IT students.

3.3 Understanding Research Philosophy

The research philosophy describes beliefs and assumptions on the development of knowledge and defines your philosophical position in research. There is three types of assumption in research that are, assumptions concerning human knowledge (epistemological assumptions), about the truths you discovered in your study (ontological assumptions), as well as the worth of your studies (axiological assumptions)(Saunders et al., 2009). Epistemological assumptions have three major types in social science research: positivism, relativism, and social constructivism. Social constructivism is selected as the most appropriate assumption for this study because it reflects on how people make sense of the world by sharing their experiences with others through the means of language (Easterby-Smith et al., 2012, p. 23). This research paradigm is focused on the assumption that humans, rather than empirical and external influences, decide "truth" (Easterby-Smith et al., 2012, p. 23). The implication of social constructivism consists of the following eight features (Easterby-Smith et al., 2012, p. 24):

- The observer is a participant in the observation.
- The greatest variety of research is human desires.
- Explanations are meant to help people get a better understanding of the situation.
- The research begins with the collection of rich data from which new concepts emerge.
- Stakeholder viewpoints should be incorporated into concepts.
- Analytical units should contain the complexities of ‘whole' conditions.
- Theoretical abstraction allows for generalization.
- Sampling necessitates the selection of a limited number of cases for special reasons.

The current research is based on the above implication of social constructivism. This approach tries to focus on people's experiences, feeling, thoughts and understanding. One of the key goals of this study is to investigate people's experience and understanding of UDR contents on the web which makes a logical approach to social constructivism.

3.4 Research approach

Based on our research objective and goal, an exploratory research design is selected and analyzed through a qualitative approach. Open-ended questions, according to Mack (2005), are better for qualitative research since it enables participants to respond in their own words. In the qualitative study technique, the researcher seeks to assess the importance of phenomena from the participants' experiences (Creswell & Creswell, 2017, p. 20). The qualitative approach looks at the subject's knowledge and understanding, as well as people's perceptions, purpose, interactions, and social structures, and contextual influences (Mohajan, 2018). Similarly, it builds holistic pictures of the study, analyzes words, reports the detailed views of audiences, and conducted their studies on natural settings (Creswell & Poth, 2017, p. 15). A qualitative research approach is selected for this thesis based on the above statements.

According to Qualitative Research Consultants Association (QRCA), the use of qualitative approaches is useful where the aim and purpose of the study are to examine strengths and shortcomings of products/brands; to investigate a product and services; to explore demographic and user groups; and to consider the understanding of a product. In our case, UDRs' websites services are investigated through end-user involvement. According to QRCA, a qualitative approach helps to achieve users' feelings, values, and perceptions, identify user needs and generate ideas for product improvements. The expected result of the current study will provide insight into the information usefulness, user experience, the usability of UDR websites and elaborates conclusion and set of recommendation to improve user experiences on UDR websites.

The verities of the data collection method are available in a qualitative study including interviews, observation, questionnaires, focus groups, tests, and secondary data. In the current research, a combination of interview and observation methods will be used in data collection. The combination of these techniques helps the researchers to understand the relationship between participants' actions and their experience with the system, and also helps to avoid the missing of some important data (Lazar, Feng, & Hochheiser, 2017).

3.5 Data Collection Instrument

This section covers the data collection instrument used in this research including aspects of task design, observation, and interview.

3.5.1 Task Design

The two types of tasks are created to suits the participants' knowledge and experience (refer to Appendix 2 and 3). Participants who have less knowledge and experience in UD are provided a general set of tasks whereas those with prior experience with UD in ICT are given a specific set of tasks. The number and complexity of tasks are slightly different based on participants' skills and experiences and different information is expected from different groups. For example, students or professionals who have no idea of UD prior before, are asked to find information about Universal Design in ICT, usability, accessibility, WCAG, ATAG guidelines, etc. In the meantime, skilled and experienced participants are asked to find special information such as navigation of menu bar, form design, web page design.

The purpose of providing a different task is to make the test more functional, logical, and equitable so that participants feel comfortable completing the task. According to Nasir Uddin (2007), the task should be structured to keep the participant engaged in looking for appropriate content; otherwise, loss of interest may have a major impact on finding. The tasks are designed based on the general needs of information seekers from UD resources. The answers to the tasks can be found within the provided web portals. Tasks are then given to all participants for the data collection process.

3.5.2 Observation

The observation method is used as one of the ways of gathering information from a user perspective while the task is performed by participants using UDR sites. This type of technique is useful in a deeper understanding of a particular topic or state by observing individual life and experience(Given, 2008). According to Hoepfl (1997, p. 35), observation can enable a researcher to see information that the participants are unaware of or unable to discuss. Observation effects are depending on the nature of observation, characteristics of the setting, personality, and procedures of the observer(Patton, 1990).

There are different types of observation techniques. The participant observation technique is used in this research. Participants' findings can be incorporated into several approaches, according to (Given, 2008), such as assessment of human actions and physical characteristics of environments, casual questioning, and paper study. It's qualitative and comes from social anthropology in the early twentieth century (Saunders et al., 2009).

Rather than calling participants to come to the researcher, researchers engage them in their natural seating during participant observation; relevant information is recorded on a field report (Mack, 2005). In this research, an important note in a notebook is taken, and participant action on screen is performed. The tasks are designed to identify the problem in the web content of UDRs pages. The participants are encouraged to share their experiences after completion of the assigned task.

3.5.3 Interview

After completing the observation of task-solving activities, post-testing interviews are taken. This helps us find the issues that are missed in the observation process. According to (Research Methods: Interviews) is the way of gathering valuable and important information for the research purpose. It can help to know a deeper and better understanding of the problem (Lazar et al., 2017).

Interview techniques help to investigate the participant’s depth of feeling, opinions, thoughts, and experience. In qualitative research, interviews are based on conversation and responding answers to researcher questions. The three categories of interview methods used in research are unstructured, semi-structured, and full structured interview (Wilson, 2013)

In semi-structured interviews, the researchers gather information in systematic ways whereas, unstructured interviews are informal. The goal of unstructured interviews is to gather in-depth information without imposing restrictions on users. There is a chance to the interviewee to become clear about events, behaviors, and belief which are related to interview topics(Saunders et al., 2009). However, the challenge of taking unstructured interviews would be having no structure, interpretation, and administering interviews (Lazar et al., 2017).

On the other hand, fully structured interviews are standardized with pre-coded answers. It is used to collect quantifiable data for 'quantitative research interviews' (Saunders et al., 2009). Researchers present the same set of questions to all participants in the same order during quantitative approaches like surveys, questionnaires, and completely organized interviews, and answer types are "closed-ended" or fixed(Mack, 2005). This rigidity has the benefit of allowing for accurate comparisons of responses across participants and researchers' sites. It does, however, necessitate knowledge of the relevant questions to ask, the correct way to ask them, and the variety of potential responses (Mack, 2005, p. 3).

A semi-structured interview is appropriate for its flexible structure, which allows freedom to the participants to share more information or can ask the participant for further explanation on the unclear topic. According to Lazar et al. (2017), semi-structured interviews provide room to find in-depth information by adding further clarification, additional questions, and additional comments in interviews.

In this research, pre-testing and post-testing interviews will be performed in a semi-structured format. We'll use the pre-testing interview to gather knowledge about users, their experience with Universal Design web resources. A post-testing interview will be held after the task has been completed. It may also help in obtaining user interactions and obstacles that they may face when looking for information on UDR sites. The same questions will be asked by all participants with follow-up questions being asked in case of problematic incidents.

3.5.4 Selecting participants

In this research, different factors are considered when selecting participants. We believe that ICT professionals and students use UDR websites more often than others. Since they may learn or experience the term UD in ICT from professional work or their academic program. As a result, they are chosen as the target group of this research. Participants are recruited using the snowball sampling technique. Firstly, a certain number of candidates are hired by contacting through email. Secondly, I asked them to recommend other people for this study. This process continued until enough participants reached.

Participant's level of familiarity with UD has provided the skew or negate the result of research. During the observation part, users who are already familiar with the term UD in ICT and have used UDR websites before would be expected to get exact information about what they want from the website in an easier and faster way than inexperienced users. Also, it can be assumed that individual intelligence is also influenced the results.

Participants of current research may have a different level of experience with UD. Students may have less practical knowledge and experience in UD than IT professionals. Since they could have more theoretical knowledge. In this situation, it is expected that they will understand the theoretical aspect of UD in ICT. We also assumed that they would encounter barriers from the website which will affect their learning experience. For the IT professional, it is expected that they will understand theoretical and coding concepts presented in UDR pages. We assumed that they follow the guidelines and standards of UD in their work.

3.6 Data analysis

In the current research, data obtained from the interviews and observations were analyzed through qualitative content analysis techniques. Content analysis is a systematic approach for condensing large volumes of data into fewer content categories based on explicit coding standards; the data may be interpreted as text, drawings, audio, or images (Lazar et al., 2017). This method also uses audience feedback, according to Lazar et al. (2017), which is input obtained directly or indirectly from an audience group. The coding technique identified data materials during analysis which involved interacting with data and making compressions between data (Lazar et al., 2017).

3.7 Research Ethics

Before conducting the research, it is important to consider ethical issues because it is the responsibility of researchers to take care of participants' autonomy, dignity, privacy, and security from risk. According to Mack (2005), research ethics helps to established trust between researchers and study participants where participants are in top priority then after research question for the researchers. The Norwegian National Committee for Research Ethics in the Sciences and Technology (NENT) have established the guidelines for research ethics(Committees, 2016). Ethical issues will be raised throughout the research; thus, it is

important to follow standard and guideline which promote ethical reflection and clear the understanding of ethical dilemmas.

This study is qualitative and involves interviews and observations with several participants. In the interviews, the researchers will be asking about general information, knowledge, experience, and participants' opinion about universal design web resources. It is, therefore, important to treat participants with kindness and give respect to their opinion and thought.

It's also crucial to clarify the objective of the study, and how the data will be used. Participants with an ICT background are invited to participate in this study. The participants of this research will get the necessary information about the study background and objective of the study, interview layout, and consequences of the participation in this research.

It would be made clear to the participants that participating in this study is completely voluntary, and that participants have the option to withdraw at any point during the study. The participants have the right to provide personal information to others and any information provided by participants will be handled confidentially. It also informs participants that screen recordings of user testing and audio recording of the interview will be taken to analyze the data. Any data that could recognize the participants will not be taken.

The ethical issue here will be the privacy of the participant which will be considered with respect and will handle in the best possible way. In NENT (2016) principles concerning the respect of the people are defined. This is concerned with written consent before the research start and the confidentiality of informants.

The consent agreement verifies that participants in this study have obtained knowledge, recognized the purpose of the study, and consented to participation. Consent is obtained for both screen recording and audio recording, according to the consent form.

3.8 Quality of research

The quality of qualitative research depends on the credibility, transferability, and trustworthiness of the study (Golafshani, 2003). Many aspects are considered to maintain

the quality of research. There are many criteria, it is feasible to feature two which are considered as principle one: reliability and validity.

3.8.1 Reliability

Reliability defines the quality of technique used to collect data in the research. Reliability refers to the data collection methods and analytical procedures used in finding (Easterby-Smith et al., 2012, p. 156). It makes the degree of research consistency that means all information needed in research is reliable. The respondent's participants in this research are from IT educational and professional backgrounds with varying age groups. To enhance the reliability of this study, individual observation and interviews are conducted.

All the interviews were semi-structured and were conducted during the personal meeting which increased the reliability of the research. Voice and screen recorders were used after being granted permission by participants, which help in taking notes and allowed more focus on interview answers. After completing the interview with the respondent, all information is transcribed to increase the focus on analyzing the answer.

3.8.2 Validity

The term "validity" refers to whether the behaviors being tested are truly reflective of what they were intended to assess (Drost, 2011). The interpretation of the findings is done with the aim of the research to the collected data from interviews and observations with participants. The collected data is derived from the feeling and experiences of IT professionals and students who may or may not be familiar with UD in ICT. The right interpretation of received information is an important factor that should be considered. For instance, inappropriate words used in sentences can lead the reader to misunderstand the information. Thus, the correct interpretation is a challenging task because English is not the native language for both authors and participants.

3.9 Summary

In this section, a selection of methodology, data collection techniques, and ethical considerations are presented. The exploratory research design is selected, and a qualitative

approach is chosen for this research. The observation and semi-interview interviews are conducted with participants. Finally, the research's validity and reliability are discussed.

4. USER TESTING AND INTERVIEWS

This chapter covers the practical exercise of user testing and interviews of the research. The chapter begins with detail about the consent form and then moves on to the procedure used in testing – what task is provided to which participant. Continue with the post-interview information, finally, participant's backgrounds are elaborated.

4.1 The consent form

Before conducting user testing and participants interview, participants must get the necessary information about the study and sign a consent form. Participants are given information about the understanding of research and its risks. According to Lazar et al. (2017), informed consent includes two parts. First, it must provide details of research purpose and procedure and other important information about research (for example potential risk, participant's rights) in a comprehensive and accessible form. The reason for providing information to participants is that it makes "a truly meaningful decision" to participate in the research (Lazar et al., 2017). Without providing research information, they may have an unpleasant experience and limit their decision in participation.

The second important part is voluntary agreement with the participant in the research (i.e., consent). Participation in the test should be fully voluntary and free of all implied or implicit coercion (Lazar et al., 2017). The informed consent aim is to provide enough information to the participant so that they can have the right to decide whether to take part or not to enroll in a study (Rose, 2017). According to Lazar et al. (2017), an informed consent form includes several elements such as research's purpose, procedures, alternatives to participation, all the risk and discomfort, time duration, benefits, confidentiality, and others.

For the current research, the consent form is written based on the above information (see Appendix 1). The consent form has other information such as information about the supervisor and researcher because this research is part of the Master thesis and participants may also need this information.

4.2 Setup of user testing

Most user testing was performed on the user device, laptop, and MacBook, in some cases when the user has no device at that moment MacBook was provided from the researchers' side. Users who had a laptop with Windows as an operating system used "Google Chrome" or "Firefox" browser to access the tested websites and those who had MacBook used the "Safari" browser for accessing testing websites. These browsers were popular and most of the users were using them, however, there was no restriction on the selection of browsers.

During all the user testing sessions, Bandicamp[4] software in the windows operating system and QuickTime default software of MacBook were used for recording screen activities. All the user testing and interviews were performed at participants' settings since it was more comfortable and convenient for them.

4.3 Procedure

Participants were provided a set of tasks based on their prior experience and skills. Unfortunately, due to time limitations, the participants were not able to test the given task on all given UDR sites. For instance, when they try to test a single task on four given websites, it may take more than five minutes in each site for searching and understanding the information. For a single task, it requires more than 30 minutes to complete. The participants' observation was challenging and demanding for this long-term taking process. However, the main reason behind not taking tasks on all websites was that none of the participants agreed to take part in such a long study for free.

[4] https://www.bandicam.com/free-screen-recorder/- Free screen recorder software

Table 4.1. *UDR websites are given to participants for testing.*

Resource ID	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
A	Yes		Yes					Yes	Yes	Yes
B		Yes		Yes	Yes	Yes	Yes			
C		Yes				Yes		Yes	Yes	Yes
D	Yes		Yes	Yes	Yes		Yes			

By considering time limitations, each participant was provided with two websites for testing given the task. Table 4.1. shows which website was assigned to which participants for completing a task.

4.3.1 User testing process

After completing the pre-interview, participants were provided a set of tasks based on their knowledge and experience on UD of ICT. Participants went through the given task on each website. Participants were using the menu and navigate to different pages to find information on the websites. Participants were requested to read content and try to understand content information on the websites. If the participants were unable to find information on the website, then an internal search engine was suggested, and a different keyword combination was used to find the information.

The user testing is participant's interaction with UDR sites so, all the screen activities and mouse movement during testing with all participants were recorded using the software as mentioned before. The participants were observed, and notes were taken on all issues experienced by participants during the testing process.

4.3.2 The post-testing interviews

After completing the task, post-testing interviews were conducted to understand the issues identified during user testing and to know the overall participants' experience with tested websites. As was mentioned before, all participants tested all given tasks on two websites. The post-testing interview questions were divided into three sections. In the first segment, participants were asked questions about the usefulness of website content during the testing. Participants were then asked questions about the web design and appearance, as well as the obstacles they encountered when completing the task. The final section includes a concern about user experience and attitude toward the websites that were evaluated. For post-testing interviews, all participants were given the same set of questions.

4.4 Participants

To understand the usability barriers from UDR sites, ten participants (P1 to P10) were selected for user testing with selected websites. Since the research is anonymous, no names were mentioned in the thesis.

Table 4.2. *Demographic information of the participants.*

Participants	**Age (Range Year)**	**Highest Level of Education**	**Occupation**
P1	25-34	Bachelor	Part-time employment
P2	25-34	Bachelor	Full-time employment
P3	25-34	Master	Student

P4	25-34	Bachelor	Full-time employment
P5	25-34	Bachelor	Full-time employment
P6	25-34	Master	Student
P7	25-34	Master	Unemployment
P8	25-34	Master	Student
P9	25-34	Bachelor	Full-time employment
P10	25-34	Master running	Student

The pre-testing interview was conducted with selected participants to gather demographic information (see Table 4.2.) such as their age, level of education, and occupation. The participants of this study were from information technology backgrounds as explained before, there were no restrictions on age, gender, or level of occupation to take part in the research. Four of the participants worked full-time in the ICT sector, four were studying full-time at university, one worked part-time, and one had no job at the time. They were all in the age group of 25-34. Five of the participants had completed a post-graduate level of education and the remaining five had completed a graduate level. Also, during pretesting interviews, information about participants' knowledge and experience on UD in ICT was conducted. The following Table 4.3. shows the participant's knowledge about UD and their intention to use UDR websites.

Table 4.3. *The information about participant's knowledge and experience on UD of ICT.*

	Knowledge of UD (Personal rating)	**Use of online resources for learning UD. For what purpose?**	**What type of information do you usually search for?**	**How often do you search for? In which situation?**	**Best website for UD information? Why**
P1	Good	Yes, for study	Research articles and books related to UD	A few times a week. Writing thesis work	https://www.sciencedirect.com/ https:/scholar.google.no/ Easier to search for information
P2	Good	Yes, for study and work	Methods and general practice	Not often when working on frontend development	W3.org, Useful information for my work
P3	Good	Academic research,	Universal design, accessibility, usability	Almost every day, for doing assignments and project work	University database library website, More resources available there.
P4	Good	Accessibility Guidelines	Accessibility and	Not often when got confused	W3c.org

		for programming	Interactive design	and issue related to accessibility	
P5	No	No	-	-	-
P6	Fair	Study	Web accessibility, usability, and Universal design	Often, while doing project and assignment	Stackoverflow, w3school, w3c
P7	Good	Study	Accessibility and Usability	Fairly, while developing the app	WCAG 2.1, have provided set rules for making accessible product.
P8	Good	Research and study	Web accessibility guidelines and legislation	Almost every day, while studying and developing applications	W3c, universal design.ie, more information also comes up at first in Google searches.
P9	No	No	-	-	-
P10	Good	Study	Web accessibility and usability	Often when studying	W3c, google search.

All the participants have good knowledge about UD except P5 and P6, P9 have fair or no previous knowledge about UD of ICT. Most of them often used online UD resources for learning web accessibility, usability, and a few of them searched for interactive design, UD general practice in ICT. The participants also have similarities in using online resources. Most of them used the w3c.org site for retrieving information, some of them used googles' search engine, university database library, center for an excellent website, stack overflow. Also, most of them used online UD resources for study purposes, although few of them used it to implement in their work.

4.5 Analysing the data

After successful completion of the data collection process (user testing, observations, interviews), the results were analyzed through qualitative content analysis technique which is according to Lazar et al. (2017), is systematic analysis techniques used to compress data into fewer content categories using explicate rule of coding. Also according to Lazar et al. (2017), it is an in-depth analysis that helps us to find theoretical interpretations, which in its turn could provide us important insights into particular phenomena.

This study was used on participants' content, where input was obtained either directly or implicitly from the audience group(Lazar et al., 2017). The data of this study were gathered using audio files of the pre-testing interview, screen recording (screen activities and mouse movement) in video files during task completion, observation notes in a notebook, and post-testing interview in audio files. According to Lazar et al. (2017), the content analysis used both text and multimedia-based information as audio or video collected from participants. The collected data from the interview, video file, and observation notes were analyzed using this technique to find some patterns in user perception of UDR content.

Afterward, based on analysis results, a set of recommendations were developed to enhance the usability and information usefulness of web based UDR sites.

4.6 Summary

In this section, the practical detail of user testing and interviews were provided. First, the information about the consent form provided the participants necessary information about the research. Then the user-testing and post-interview procedure were provided. Each participant was given two UDR sites and a set of tasks for user testing based on their knowledge and experience. The participants' knowledge about UD in ICT and the purpose of using UDR websites were collected from the pre-test interview section.

5. RESULT AND ANALYSIS

The results of the data analysis are presented in this chapter. The first section contains the results of user testing gathered through observation and interviews, while the second section contains user preferences shared by participants during the data collection process. The third section includes participants' suggestions concerning UDR, and a summary of the results is presented in the final section.

5.1 User testing results: Observation and Interview

The results of user testing through observation and interviews with participants are presented. Participants' interaction with UDRs during user testing was observed. All the issues faced by participants were carefully noted by the observer. Additionally, all the screen activities during the user testing session were recorded. The data analysis results show that many users experienced several issues when testing UDR websites. The findings from user testing and observation were supported by summarized post-interview data. The combination of these methods helped to look at the founded issues from different angles.

Most participants said that the UDR materials were extremely helpful and insightful to them. Despite the obstacles, they were able to navigate the websites, find the information, read text, and attempt to comprehend content information, as well as engage in the post-interview session. Most participants accepted that UDR contents are an excellent way for them to learn, extend their knowledge, and help them applying universal design, accessibility, and usability concepts in their work. Many participants were agreed that most of the UDR content was clear, simple, and easy to comprehend. During post-testing interviews, some of the participants also expressed that they were willing to revisit the UDR site to learn more about accessibility and usability in ICT.

During user testing, however, participants encountered several obstacles related to website content, design, and presentation. Some participants had a poor experience with the content and design of the websites. Their poor experience with the website negatively affected their attitude towards the UDR content and could stop them from learning and

retrieving information about UD of ICT in the future. The following subsection lists all the problems that are identified in this study.

5.1.1 Content related issue

All the issues related to the content of UDR sites are listed in Table 5.1. as shown below.

Table 5.1. *The content-related issues that were discovered from the study.*

Problem Theme	**Issue: sub-theme**
Content clarity	• The jargon word used • Irrelevant information • Lack of title, sub-title, and description details • Huge information in a single page creates cognitive load
Informativeness	• Lack of information • Missing practical examples and implementation details
content relevance	• Extra information • Old content
Credibility	• An issue in finding the required information while using the search function • Menu was confusing • An issue in some authority attributes (e.g., information completeness, writing style, and currency)

Several content-related problems were discovered through user testing and participant observation. In the following subsections, each of the problems is described.

Content Clarity

The content on the UDR site is a major part that influences the user to visit and re-visit the website. To improve text clarity, all the websites arranged and displayed content in various formats. After the post-test interview, most of the participants stated that the content was clear, understandable, and detailed in tested UDR websites. However, some of the participants had difficulties in understanding content information. They mentioned that difficulties were due to jargon word use, length of sentence, heading, subheading, incomplete information, proper formatting, and hierarchy of information. For instance, after testing site A, participants P1 said that "*Some of the keywords that I have no idea, was made difficulties to understand text information*". Participants who have tested the site B and D stated that the information they received was insufficient. Participant P4 tested the site D mentioned that "*I was able to understand the content information, but it was not very easy. In some cases, the contents were linked to different pages and not readily available".*

A lot of information present on the same page (as see Figure 5.1.) was created difficulties to understand content information to users. Participant 6 mentioned that "*The w3c portal had a lot of information on the first page, which caused cognitive load and made it difficult to interpret the information on the website*".

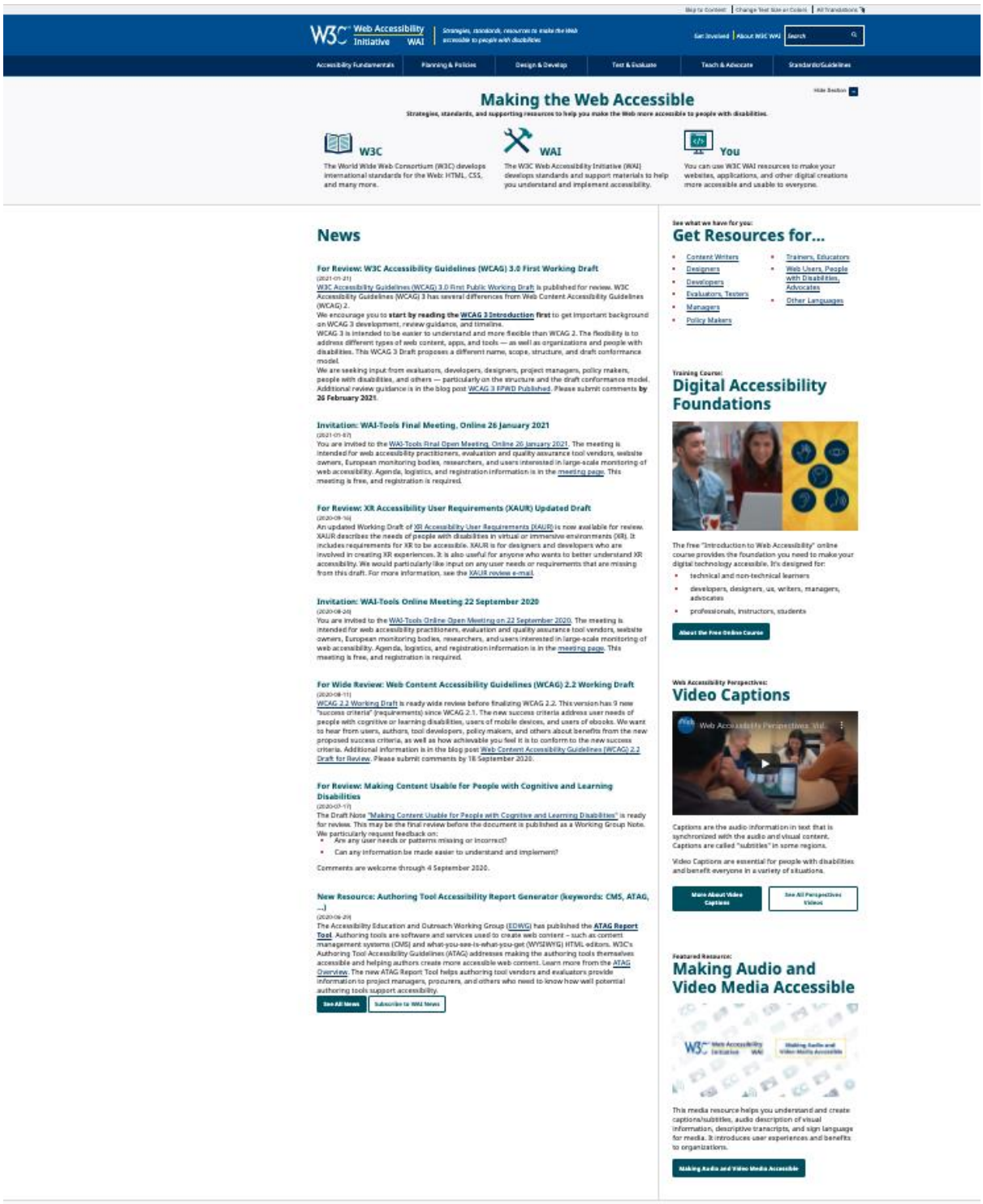

Figure 5.1. Home page of W3C Web Accessibility Initiative site

Content Informativeness

During the post-test interview, most of the participants mentioned that information on UDR websites was informative to them. Participant 2 said that "*I got a chance to learn something new about web accessibility*". Participants 2 and 9 also expressed a desire to revisit the UDRs' websites to learn more about specific topics. Despite the useful information provided on the UDR pages, some participants were expecting to get more practical examples. UDR sites, according to participants 1, 5, 7, and 8 had more theoretical knowledge about UD in ICT than practical examples.

Content relevance

During the post-test interview, several participants said that UDRs content was very useful in learning theoretical aspects of ICT accessibility and usability. They accepted that the UDR portal had updated and important information. However, participants' confidence in using websites has diminished because of broken links and old contents on Site D. In addition, missing information in some subjects, as well as extra or excessive information in others, caused problems with content relevancy. Participants 7 reported that site D had too many details on certain subjects, making it difficult to find appropriate information.

Credibility

Most of the participants said the content of the other three websites had referenced the contents of site C during the post-test interview. They also mention that web content was reliable, as all the websites were well known and developed from trusted organizations. However, negative experiences with website design, presentation, and content raised concerns regarding the websites' reputation. Participant 3 said that "*I feel like NDA site has more up to date content than Tarleton university site, although I found that both websites follow updated w3c content*". Some participants got a challenge from the appearance and organization of the menu on the university UDR's websites. Furthermore, some participants had difficulty finding information using websites' internal search functions in all UDR websites. Participants' views of the UDRs' reliability and trustworthiness were negatively impacted by these problems.

5.1.2 Design appearance-related issues

During the post-test interview, participants were asked a question about the design and appearance of UDR websites. Also, tried to figure out what issues they had when completing the given task on UDR pages.

Table 5.2. *Design and appearance related issues were discovered from the study.*

Problem Theme	**Issue: sub-theme**
Appearance	• The search bar in the Washington site was small with no search field. • The menu position on the right side of the window in University UDR sites was not as usual for some participants. • There is no way to change the font size in Site A, Site B, and Site D (e.g., small size) • Two different menus appear on the same page on universities site create confusion among participants
Organization	• Lack of categorization of information based on target group in University UDR sites. • Missing sub-categorization of information in the menu on the site B
Findability	• Ineffective internal search • It was difficult to find all information from the menu • Lack of hint option in the search function.
Navigability	• The navigational support was insufficient (e.g., difficult to navigate from university main website page to accessibility page in University UDR websites.)

	• Broken links in Site D
Labeling	• Lack of proper title, sub-title, content description

All the identified issues related to the design and appearance of UDR sites are listed in Table 5.2. Each of the problems is outlined in detail in the following subsections.

Appearance

The appearance of the UDR websites was evaluated based on the participants' perceptions of the challenges they encountered when completing a task. Most participants said that all UDR pages had a nice interface and that they could quickly use the website to retrieve information. However, some participants also had issues with the UDR pages' design and appearance. The following is a list of appearance issues that participants experienced when using UDR websites.

Layout

Some participants faced layout issues while doing tasks. One of the problems that participants encountered was the tiny search icon and no search area on site B. The search area appears at the top of the web after clicking the search icon, which was not obvious to the participants. Participant P1 tested site B and said that "*I couldn't locate the search bar at first because there was only a search image symbol, which created confusion; I was expecting a search icon with a search field*". Participants 1, 3, and 6 had another issue with menu positions on university UDR websites. They looked at the menu on the left side as usual but found that the menu on university UDR pages was on the right side (as see Figure 5.4.).

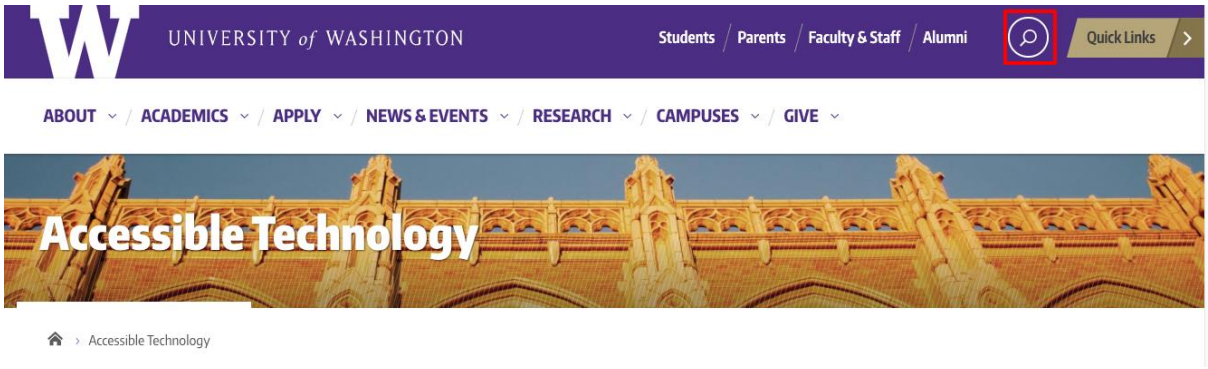

Figure 5.2. University of Washington UDR's search icon before a user pressed it.

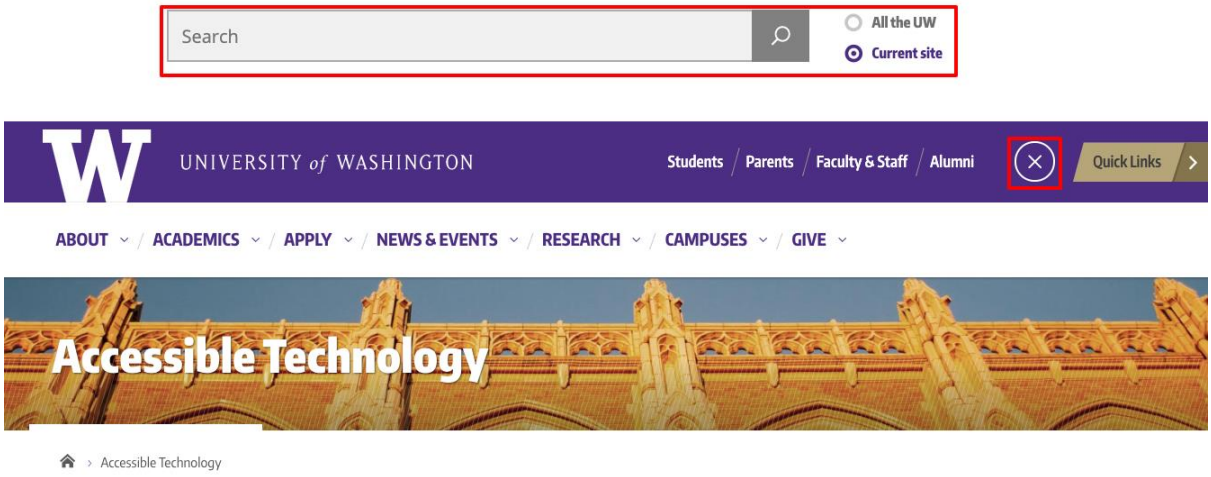

Figure 5.3. University of Washington UDR's search function after a user pressed the search icon.

Figure 5.2. shows the Site B search option. There was no search field visible until clicking the search button. The search field was shown at the top of websites after clicking the search button (as see Figure 5.3.).

Menu

The appearance of the menu often creates trouble for some participants. University UDR sites used different menus for university information and different menus for accessibility information (as see Figure 5.4.). It was observed that the participants P1, P3, P4, and P6 went to the main menu to complete the task in University UDR sites. They expected all the information were available in the main menu on university UDR sites. On the other hand, the participants expressed that the site A and C menus were beneficial and contained information that helped them to complete the task.

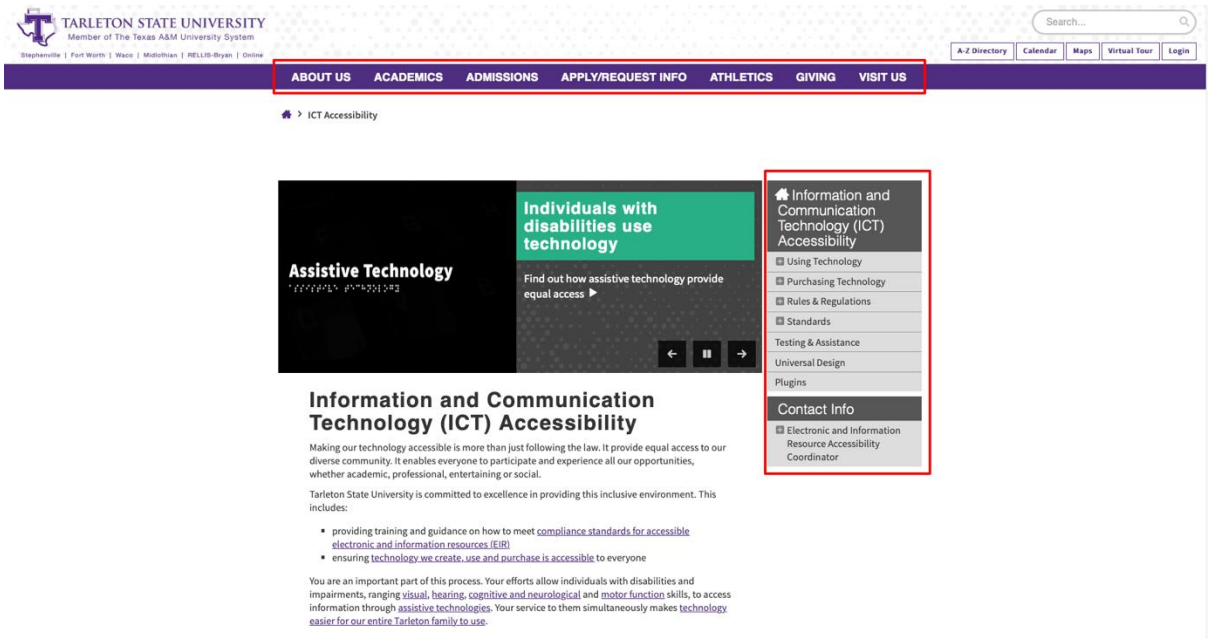

Figure 5.4. The Home screen of Tarleton State University UDR sites.

Above Figure 5.4. shows Tarleton State university UDR's home page. You can see that there is a separate menu for university information and a separate menu for UD information.

Organization

During the post-test interview, participants responded that they were facing difficulties from the organization of information in terms of content presentation, information hierarchy, and menu position. According to many participants, the content of sites A and C was well structured. In both sites' information was organized based on the target group for example student, developer, designer. However, the information was not organized based on target users on the other two UDRs websites. The lack of categorization of information on Site B and Site D created difficulties for participants P2, P5, P7, and P8.

Another problem faced during task completion was the logical organization of information. Although most of the participants said the presentation of content was very logical, others said they had trouble finding it. Finding information through the menu on university UDR websites was not easy for some participants. Participant 2 said that "*there was no orphan menu for categorized information in University of Washington UDR site*". He was expected sub-categorization of information in the menu that could help him in finding information. Instead of using the menu, many participants prefer to use the search bar and said that it

was an easy way for searching for information. Although the menu was very beneficial and helpful in finding information in other two sites.

Information Findability

Most of the participants were able to complete tasks and able to find information from UDR sites using the search function, menu bar. However, some participants had difficulty finding information on the UDR websites. Some participants struggled to find detailed information across menu items. "*I couldn't find what I was looking for in the menu, so I turned to the internal search option,*" P3 said after testing the site D. Other participants shared similar experiences on finding information through a menu on other UDR websites.

During the post-test interview, many participants mentioned that they had problems finding information using the search function. After reviewing the steps that participants took during their search, the use of keywords was discovered to be a significant issue in the search process. Many related keywords were used but participants were unable to find the exact result from the search function. When looking for information about UD in ICT, for example, various keywords were used, such as 'universal design,' 'accessible design,' 'accessibility,' and 'usability' all of which contributed to similar findings.

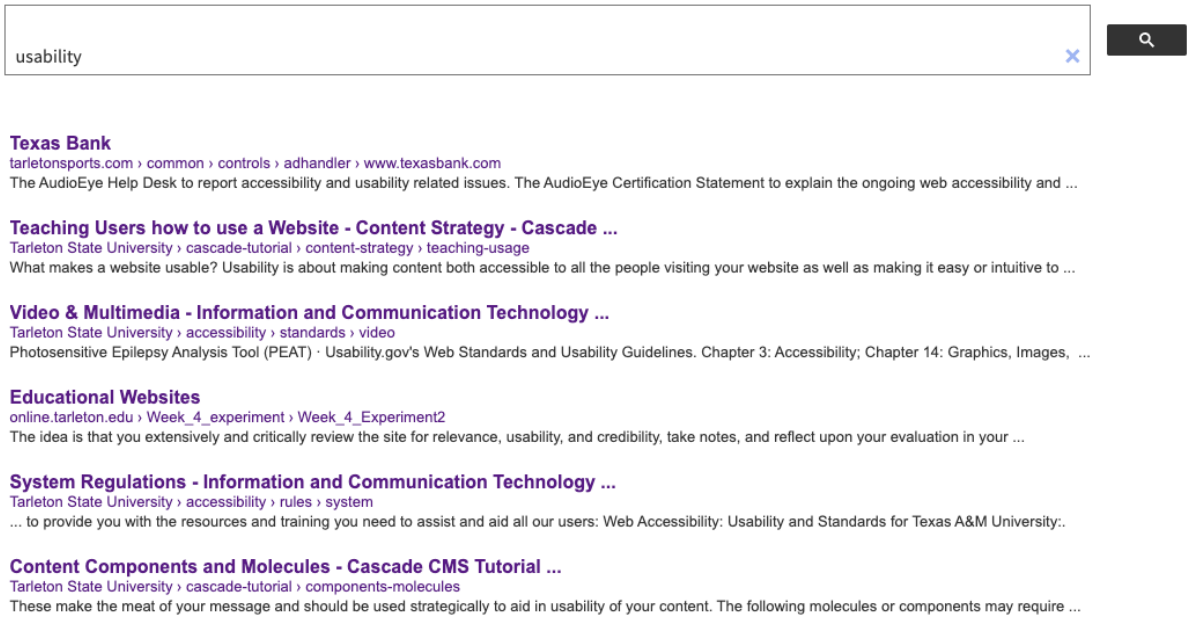

Figure 5.5. Tarleton State University UDR's search result for the keyword "usability".

Figure 5.5. shows the search result for the 'usability' keyword in Site D. A related search results were found for the usability topic, but the participant expected to get exact information about usability in ICT.

Navigability

Most of the participants said that location identifiers present in sites help them to know their current location. However, participants P2, P4, and P9 mentioned that it was difficult to navigate from one page to another in university UDR sites. For instance, navigating the Home page to the Accessibility page was difficult. The university UDR websites had limited information but have a link provided on pages. When opening the link, it redirects to another website which made participants confusion where they are on the site. Also, some of the links provided on University UDR pages were invalid which negatively affect their experience in UDR sites.

Labeling

The title, sub-title, and content description of University UDR websites create difficulties for participants to read and understand the information. The long title heading, and lack of proper explanation of the link in site D cause trouble in reading and understanding content. Although participants mentioned that these were minor issues, it could make content more readable and understandable.

5.2 ICT professionals' and students' preferences

The final section of the post-test interview was designed to find out what ICT professionals and students thought about UDR websites, their content and which one they preferred. There were asked a question like ("How did you experience UDR sites? What do you think about them?", "Which of the UDR contents do you like most? Why?", "Which of the information presentation formats do you like best? Why?" so on.

The results of user testing and observation identified several usability problems that participants encountered when using the UDR websites. Some participants expressed the design of university UDR pages made it hard to find the information. They were confused about the menu present in university UDR sites (They explained that the university

information menu and accessibility information menu present on the same page that made confusion). Although, two participants, who have tested site B (P2 and P4) expressed a positive opinion. According to them, the content on Site B was well-presented, with appropriate titles, headings, and font sizes.

The participants expressed a different opinion about UDR websites and their content. Their opinion was based on their experience and the barriers they had faced from UDR websites. Most of the participants said that all the UDR websites were a great way of learning theoretical information about the accessibility, usability of ICT. Some of them would like to revisit websites to learn more about UD in ICT. However, some participants stated that clarity, informativeness, and relevance of information influenced their willingness to use UDR pages.

Many participants preferred sites A and C, according to them there was detailed information, and information were categorized based on the end-user (e.g., developer, designer, an educator). Participant P9 said that "*I found W3C site categorizes information based on user knowledge and experiences, which makes it easier to understand information*". Some participants liked the content on Site B. Participants P6 tested Site B said that "*I was searching for 'accessible form' information and found content that was clear and presented with a practical example. I was really impressed by the information*". Participant P2 liked Site B because information on some topics was described from video materials.

5.3 ICT students and professionals' suggestion

To get a better understanding of the ICT students' and professional's perception of tested UDR websites and their opinion on them, the participants were asked that what things they would like to change in tested UDR websites ("Would you like to change something in design and appearance and content on a website? What exactly?", for the interview guide see Appendix 3)

The participants mentioned the lack of organizing information based on the target group, Jargon used in the content, design, and appearance of UDR sites as a big issue for them. Most of the participants suggested that UDRs content should be organized based on the target group in University UDR websites. It would be very helpful and would solve the

problem in finding and understanding information based on their knowledge and experience. In addition, some participants suggested that using easy and well-known words in content would help them learn and comprehend information more quickly. Participants P1 and P6 suggested that presenting information on different pages would reduce the cognitive load and help them on reading and understand content information.

Also, participants P2, P4, P5 mentioned that clear and suitable title, sub-title, heading used in UDR content make the information attractive and impressed them to read the content. Most of the participants suggested that auto-correct filling search keywords on the website would be very helpful to find the exact information. Participants P2 and P9 believe that UDRs content with audio and video material would be very useful in learning the basic information on UD. In addition, participants P5, P8, and P10 would like to see multilanguage support on the UDRs website.

5.4 Summary

In this chapter, the results obtained from user testing, interview, and observation are provided. The empirical finding shows that participants faced several usability and content-related barriers during the information-seeking process on the tested UDR sites. All the identified issues are summarized in the table. Finally, information about participants' preferences and suggestions are provided.

6. DISCUSSION

The following section presents the discussion about how the practical results of the study contribute to UDR investigation and the UD field overall. The chapter starts with a discussion on ICT professionals' and students' attitudes towards UDRs content, continues with participants' perception of UDRs content. Then, usability problems in the design, organization, and search of the UDR websites during their information-seeking process are discussed. Following that, a set of recommendations are suggested based on the study results. In the final part of the chapter, limitations of the study are provided to show areas of potential improvement for future research in UDRs.

6.1 ICT professionals and students' attitude towards UDR content

All the participants of the current study had a positive attitude towards UDRs content for perceiving UD information, as discussed in the previous chapter. During the post-testing interviews, participants said the UDRs content was very useful and informative in learning and implementing UD in ICT. Some of the participants said that the UDR websites contain useful information and they intended to return to revisit the website. Other participants expressed a similar opinion about UDRs content. Participants' opinions on UDR content support the literature review findings. For instance, Chris M. Law et al. (2008a) stated that well-designed UDRs help to transfer UD knowledge to users and promote UD activities. However, participants experienced some usability issues that create difficulties in perceiving information from UDR websites.

These findings confirm the result of another study (Chris M. Law et al., 2008a, 2008b). According to their findings, UDRs do not consistently answer the needs of the designer as end-users due to a lack of usability.

6.2 Perception of UDR content

The findings from user testing and observations show that many participants experienced difficulties in perceiving information from UDRs content. Participants have faced issues related to unclear contents, not enough detailed information, presentation of contents, reliability, and trustworthiness of UDR information.

During the post-test interview, most of the participants said that unclear and incomplete content present in UDR pages created difficulties in perceiving information. According to Thielsch and Hirschfeld (2019), content clarity is one of the reasons people visit and re-visit websites. Some participants said that they struggle to understand content due to jargon words used in the website's content. This result supports the Leavitt and Shneiderman (2006) statement. According to them, jargon words used in the contents hinder the user's ability to search for information and understand it.

Some participants faced cognitive load during reading and understanding information present on a web page. The huge information present on the first page of Site C made it difficult for some participants. Albers (2011) states that cognitive overload can occur from several factors such as stress, time pressure, unfamiliar environment, memory limitation, and poorly designed websites. The number of the word present on the first page of Site C had more than 600. The huge information present on the first page reveals the universal design guideline for online services. According to the guideline, there should not be more than 600 words on the first page(Design, 2011, p. 15). This finding also supports Thomas (2020) statement. According to him the vast volume of information on the first page increases the cognitive load and forces users to read the information again and again (Thomas, 2020).

In addition, the findings show that improper title, sub-title, and lack of detailed explanation reduce the content clarity. Some of the participants state that the title, heading, subheading used in Site D was not appealing to them. Participants 2 and 5 said that there needs to improve the content organization by using the proper title, heading, and subheading in University UDR sites. As was mentioned in the literature review chapter, Leavitt and Shneiderman (2006) said that to improve the content structure, one needs to use a proper title, heading, sub-heading, paragraph, color, the font in the website content. Furthermore, a clear and logical organization of information reduces the chances of users being bored, disinterested, or irritated (Leavitt & Shneiderman, 2006).

Another issue was the informativeness of content present in UDR sites. Some participants said that there was a lack of information (e.g., information about making responsive mobile applications, WCAG 2.1.) presented on university UDR sites. With these issues user interest

to visit and re-visit the website was reduced. It can be assumed that this result confirms by Kang and Kim (2006) study.

Most of the participants said that information present on all UDR websites was relevant to them. Some of the participants said that Site A, Site B, and Site C have relevant and updated information than Site D. This finding supports the Fink-Shamit and Bar-Ilan (2008) statement, they said that the relevance of information based on the search result and user need. However, some participants reported that the UDR website contained irrelevant content or extra information that was not important to them. For instance, more theoretical information about accessibility, usability was provided. There were missing practical examples, about mobile accessibility, navigability in University UDR sites. These results demonstrate the importance of providing relevant content to their target audiences on UDR websites.

Another issue related to the reliability and trustworthiness of UDRs content. Some of the participants had a poor experience of using UDR websites that may impact reliability and trust on UDR sites. The poor user experiences from UDR sites were due to the design and appearance of websites. Sbaffi and Rowley (2017) said that good design and appearance of the website create a positive impression about the website which ultimately improves the credibility of information. These results show the importance of content and usability of UDR sites for ICT professionals and students.

6.3 Design and appearance problems on UDR sites

According to the result of user testing and observation, all participants experienced usability issues related to the design, organization, and internal search function of UDR pages during their information-seeking process.

The design of UDR websites made it difficult for participants to scan through general information, as they couldn't find it through the menu subjects and sub-subjects. Some of the participants said that all the UDR websites had a menu but finding information through the menu was difficult. We also observed that participants spent more time searching for their required information at menu items, and sometimes they were confused in searching for their topics. This finding supports the Jacko and Salvendy (1996) study, they stated that

the perceived complexity of the menu increases as the hierarchical depth of the menu increases. This result demonstrates that there need to improve the categorization of menu subjects and sub-subjects.

According to some participants, the placement of a menu on the University UDR websites created problems. The menu was on the right side of the website which caused them frustration and decreased their satisfaction. This may be because the menu is usually found on the page's left side, either horizontally or vertically. As a result, when browsing the UDR webpage, participants expected that menu position to be on the left side. This result corresponded to the menu guideline given by W3C (2019).

The organization of information on the university's UDR pages was another problem that made it difficult to find information. University UDR websites have no categorization of information based on the target group which makes it difficult to interpret information based on participants' expertise. Lynch and Horton (2016) state that logical organization of information is a basic criterion for categorizing information on the web from general to specific. Also, information can be structured, according to Leavitt and Shneiderman (2006), by placing essential information near the top of the web, categorizing related items, and making necessary information available to users.

Due to the barriers in the appearance and menu items, as well as the categorization of contents, participants preferred to choose the search feature. They did, however, have an issue with the search feature, which restricted their ability to use UDR websites and access the information they needed. The search feature did not always work properly when looking for information. Users were more likely to get the desired result if they used the correct keyword while searching; otherwise, they would have to waste time looking for the information they needed. When participants were unable to locate relevant information, we discovered that they thought there was no answer available on UDR websites rather than considering using the correct keywords. As a result, it appears that the search function was not functioning for those who do not know the right keyword. Many participants were suggested that the hints option could improve search performance. This finding confirms from Bandos and Resnick (2004) study. Their findings revealed that having content in a search hint would help boost search results.

Another issue was related to the accessibility of the search bar on University UDR sites. Some of the participants couldn't see the search box on site B because it was too tiny and didn't have a search field. According to Pernice et al. (2001), the search bar should have a search box that helps the user to enter the word and search the information.

Participants become irritated or discouraged because of weak navigation support on university UDR pages. This was because participants were having trouble navigating to the UDR pages from the main University site. Participants must either enter the exact URL for the UDR page or use the search function to locate the UDR page. Even though a location identifier was provided on the page.

Another issue was related to labeling in University UDR sites. It was observed that long title heading and lack of proper explanation of link presented on Site D were found to be causing difficulties for the participants. This finding supports the design guideline for online service which state that number of word used in heading should not be more than 8 words (Design, 2011, p. 15). According to Leavitt and Shneiderman (2006), headings should be distinct and descriptive, allowing users to locate the details they need.

These results show that UDR websites have usability issues that prevent users from obtaining information from the pages. The findings of this study support previous research findings in UDRs' usefulness from users' perspectives. This result once again emphasizes the importance of contents, accessibility, and usability of UDRs websites.

6.4 A set of recommendations

Based on the result of current research, the following set of recommendations can be provided.

General recommendation

- The internal websites' search functionality which helps to find the information easily should be improved.
- Each page should have a title, sub-titles, headings to improve the readability of UDRs contents.

- The length of headings should not be too long, as this will make it easier for users to focus.
- To minimize cognitive load, it is important to reduce the amount of information on the first page of a UDR website.
- UDRs should have multilingual support which would improve a quality of a portal.

Specific recommendation

- There should be the categorization of UDR information based on the target group of users (e.g., developer, student, content writer).
- UDR web pages should be separate from the university websites.
- The terminology used in UDRs should be well described and presented to the users in a manner that is understandable to them.
- UDRs should have practical and detailed examples that help to implement UD in work.

6.5 Limitations of the study

One of the limitations of this study is the limited number of participants. Only ten participants were recruited for testing due to the coronavirus epidemic, among them five were full-time IT students and five were ICT professionals. Unfortunately, due to the limited amount of time, the participants were not able to test all UDR sites, so each of them tested two UDR websites selected for the research.

Another limitation of the current study is the limited number of UDRs tested. Especially considering the three selection criteria i.e., web-based resources, google search engine, and international perspective, four UDR sites were selected for evaluation. Among the selected UDR sites, two sites were developed and maintained by the disability organization group and the rest of the two sites were developed and maintained by educational institutes. All UDR sites contain UD information, standards, guidelines, and legislation about UD in ICT and organized content in the best possible way. However, many other websites are providing UD information in a different format.

The language used in the user testing and interview was English. Most of the participants believe that they understand the English language, however, some participants took more time to respond to the researcher's questions. During post-test interviews, they tried to describe their experience and the barriers they faced using UDRs, but they had difficulties expressing their thoughts due to language limitations.

Summing up, considering certain limitations, the work presented in this research may still be a valuable contribution to the study of UDR's website usability.

6.6 Summary

In this chapter of the current research, the empirical results were discussed concerning past research findings. The findings from post-test interviews and observation show that ICT professionals and students express a positive attitude towards UDRs content. The results also identified the issues in perception of UDRs content (issues related to clarity, informativeness, relevance, trust, and reliability) and usability of UDR websites. Based on current research findings, a set of recommendations were developed. In the final part of this chapter, limitations of the study were presented to show propositions for future work in this area.

7. CONCLUSION AND FUTURE WORK

7.1 Conclusion and contribution

The aim of this study is to fill the gap in this research area, which is caused by the lack of empirical studies with target audiences. I looked for usability barriers in UDR websites as well as the interpretation of UDRs content among ICT professionals and students. The finding from user testing, interviews, and observations discovered that there exist usability issues on UDR websites. These issues are identified from website design, search system, information organization, labelling, and contents of UDRs websites. Our study also shows that ICT professionals and students have a positive impression on UDRs contents as the source of learning UD of ICT. However, different information attributes in UDR content create difficulties in perceiving information to the participants. Content clarity, informativeness, relevancy, and credibility of information attributes have influenced participants' perceptions of UDR websites. Based on findings from this research, a set of recommendations for potential usability, accessibility, and information quality improvement of UDRs for IT professionals and students were provided.

7.2 Future research

Since there has not been much research done on web based UDRs, so there is still space for more research in this field. The finding of the literature review showed that usability, aesthetics, and contents issues in UDR websites were not sufficiently investigated from the end-user's perspective and this research was not focused on the aesthetics of UDR sites. As a result, the UDR websites' aesthetics topic could become a focus of future research.

The sample size of participants and UDR websites could be considered as the main limitation of this research. Even the sample size was adequate for qualitative research, it would be preferable to have a larger sample size and more UDR websites would be suggested for future study. Another suggestion is that testing different formats of UDRs in different ways to see how effective they are to the target users.

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APPENDICES

Appendix 1: Consent Form

Consent form

The current research is part of the Master Thesis in Universal Design of ICT,

Department of Computer Science, Faculty of Technology, Art, and Design,

Oslo Metropolitan University

The information about the Student:

Name: Pardip Sharma

Phone: 93945223

E-mail: Pardip235@gmail.com

Title of the Study: Evaluation of universal design web resources: usefulness and user experience

Purpose of the Study: The goal of this study is to look at the challenges that ICT professionals and students face while using UDR's websites.

Procedures: To take part in this research, participants must attend one meeting which will last approximately 2 hours. We will invite you to 1) answer general questions about your expertise and experience with UD of ICT during the meeting, 2) do some tasks using UDR sites while researcher is observing, and 3) participate in a post-interview where your experience and barriers faced in part 2 will be asked.

Risks/Discomfort: There are no known safety risks associated with taking part in this study. You should take a break if you are uncomfortable or tired during your participation. You will be given many chances to take rest in case of discomfort as well as the possibility of taking additional breaks.

Benefit: Your involvement will help to shape the study's findings, which we hope would help improve the UDR websites in the future.

Alternative to participation: This study is completely voluntary, and you can withdraw or stop participating at any time. If you cancel or stop being included in the study, there will be no consequences. You have the right to request that your personal information be removed from the study.

Confidentiality: The information gathered during the research will be kept highly confidential. Since no confidential data can be obtained from the study, it is not informed to Norwegian Center for Research for data collection. During the observation, screen capture can be used to monitor only the action that occurs on the screen. After the study, screen recorded data will be deleted. There will be no personal details about the participant in this study.

I have read and comprehended the study's information, and all the information in this form is explained to me and I am eager to participate in the study.

_____ _____

Signature Date

If you have any more question about the current study, please feel free to contact Pardip Sharma, e-mail: pardip235@gmail.com

The Supervisor of the Master thesis:

Anna Nishchyk,

PhD Candidate at Oslo Metropolitan University.

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Appendix 2: Task

General Task

You are a student or from an ICT professional background such as designer, developer, programmer and may want to know more about Universal Design in ICT. You would like to learn about the Universal Design principle and guidelines. Please do the following tasks to find your information using four selected Universal Design Resources for study, try to use the search function if you are not able to find the information.

a. Find information about what is Universal Design in ICT from given UDR sites.
b. Find information on what is the difference between web accessibility and usability.
c. Find the information on how to make a responsive website?
d. Find information on what is the difference between WCAG, ATAG, and UAAG.
e. Find the new guideline that is added in WCAG 2.1.
f. Find information on the web accessibility component?

Specific Task

You are looking for technical or theoretical knowledge about Universal Design. You would like to browse any information related to Universal Design while working in your job or study. Please do the following tasks to find your information using given websites, if you cannot find information then use the search function.

a. Find the information on how to make accessible navigation?
b. Find the information on how to manage color contrast on the website?
c. Find information on how to make readable and understandable content on a website?
d. Find information on how to make a responsive mobile application.
e. Find information on accessible form design?
f. Identify the necessary information to make accessible tables on web pages?

Appendix 3: The Interview guideline

1. **Pre-testing interview**

a. Socio-demographic information
    1. How old are you?
    2. What is the highest level of education you've completed?
    3. What is your occupation?

b. Knowledge and experience on UD of ICT
    1. Do you know about Universal Design?
        a. If "yes"
            - Where do you learn it?
            - How would you rate yourself in UD knowledge?

    2. Do you use online resources for learning UD? If "yes", for what purpose?
    3. What type of information do you usually search for?
    4. How often do you look for specific information about UD on the web? In which situation?
    5. Which website do you mostly use for UD information? Why?

2. **Post-test interview (after task completion)**

- **Questionnaire about Web Contents**

1. How did you find the content comprehensiveness in given UDR sites?
2. Did you successfully find what you were looking for and if not, what were you expecting?
3. What did you think about web content information in terms of content relevancy, up to date?
4. What did you think about the informativeness of web content?
5. How did you experience the language of the web content?

- **Web Design and appearance**

If the user used the search function, then
1. Why did you choose the search function instead of using menu items?
2. How did you find the experience of using the search function to complete a task?

If the user used a menu, then
3. How did you find the experience of finding information by navigating through menu items?
4. What do you think about the information presentation format?
5. What did you think of the layout of the website?
6. Did you experience any difficulties? If "yes"
    a. What kind of difficulties did you experience?
    b. What do you think were the causes of difficulties?
7. Would you like to change something in design and appearance and content on a website? What exactly?

3. Post-test interview (after all UDR sites)

1. How did you experience UDR sites? What do you think about them?
2. Which UDR site content have you experienced as more easy or difficult to understand than others? Why?
3. Which of the UDR contents do you like most? Why?
4. Which of the UDR content seemed more comprehensive than the other? Why?
5. Which of the UDR contents do you find more informative than the others? Why?
6. Which of the information presentation formats do you like best? Why?
7. Would you like to use these UDR sites for learning UD in ICT in the future? Why?