

# Walden University

College of Management and Human Potential

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Jacqueline Shaw

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Walden University  
2023

Abstract

Exploring Strategies in Website Development in Human-Computer Interaction for Older

Adults Over 65: A Case Study

by

Jacqueline Shaw

MS, Walden University, 2018

MS, City College, City University of New York, 1991

BA, City University of New York, 1989

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Information Technology

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## Abstract

Human-computer interaction (HCI) website developers often lack the understanding necessary to build interfaces to meet accessibility requirements for older adults over 65. Adults over 65 often have difficulty using computer technology to access information over the Internet and are slow to adapt because websites are not fully accessible to older adults. Grounded in the technology acceptance model, the purpose of this qualitative multiple-case study was to explore strategies that HCI website developers use to build interfaces to meet accessibility requirements for older adults over 65. The participants were four HCI website developers from four website development companies in the New York City metropolitan area of the United States. Data were collected using semi-structured interviews and organizational documents. Using thematic analysis, the major themes found were ease of readability and accessibility, ease of navigation and simplicity, and the importance of feedback. A key recommendation is for web designers and developers to use best practices and guidelines identified by the World Wide Web Consortium to create accessible websites for adults over 65. The implications for positive social change include the potential to improve the number of websites that are easier to use for older adults, thus providing benefits to older adults by enriching their worlds, allowing their families to use distance communication to interact with them, and affording health providers with an avenue to have more contact with the older adults.

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## Dedication

Thanks to the higher power for giving me the strength to complete this study. This study is dedicated to my son, Christian Shaw, for believing in me. Christian, I would not have continued without your constant encouragement to hang in there. I know someday you wish to follow in my footsteps and achieve a terminal degree; I am proof it can be done. Always constant.

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## Section 1: Foundation of the Study

Older adults over 65 face challenges when accessing the internet due to accessibility issues. Older adults encounter accessibility issues when accessing websites that provide daily communication activities and information relevant to their daily living (Mitzner et al., 2016). In this study, I identified strategies used by human-computer interaction (HCI) website developers to create accessible websites for older adults and provide practical strategies for HCI developers lacking this skill set.

### **Background of the Problem**

Computer technology has evolved to include many communication devices, such as smartphones, laptops, game systems, GPS devices, tablets, and more. Technology advancements, including emailing, video conferencing, locating places, chatting, and exchanging images, are standard but are not always easily accessible by older adults (Mitzner et al., 2016). The technical ability to contact friends and family to maintain relationships is more accessible with these devices, and older adults can reach a broader social support network by using these communication activities (Gonzalez et al., 2015). However, the ability of older adults to use these hardware devices to communicate with their families and maintain social communication produces challenges for them (Gonzalez et al., 2015).

The internet has become the primary source of accessing information by individuals today. Accessing the internet via multiple devices allows users to be anywhere where there is internet connectivity and gain access to information. Individuals use the Internet to shop, pay bills, go to school, do taxes, communicate with health

professionals, access medical and health information, and sign up for retirement benefits (Gitlow, 2014). However, older adults are often not skilled in accessing these resources. Researchers have found that although older adults are not proficient in using all the typical applications, they use their computers to access the internet, and their primary use of the Internet is for email (Mitzner et al., 2016).

### **Problem Statement**

Older adults over 65 use computer technology to access information online but are slow to adapt because HCI web developers do not build fully accessible websites for that age range (Gitlow, 2014). Over 50% of adults over 65 use the Internet to access medical information and for social support use, but despite these older adults' use of computers and other devices to access the Internet, 80% to 95% that seek assistance via the Internet face challenges in accessing information due to very few options for accessibility (K. Williams et al., 2016). The general information technology (IT) problem was that there was a lack of accessibility options on websites used by older adults over 65. The specific IT problem was that some HCI developers of websites lacked strategies to build interfaces to meet accessibility requirements for older adults over 65.

### **Purpose Statement**

This qualitative multiple case study explored HCI website developers' strategies to build interfaces to meet accessibility requirements for older adults over 65. The targeted population was HCI website developers and designers with knowledge and experience creating websites with accessibility options for adults over 65. The study was conducted with participants from website development companies located in the New

York City metropolitan area of the United States. The results of this study may provide strategies for HCI web developers to build accessible websites directed toward older adults over 65. The implications for positive social change include the potential for older adults over 65 to have full access to technology that may change their daily lives by allowing them to use the internet with fewer challenges to connect with services that will enable them to communicate with loved ones and use services, such as health care and productivity programs.

### **Nature of the Study**

In this study, I used a qualitative research approach. Qualitative studies are conducted to explore and understand individuals' experiences or groups associated with a social or human problem that involves emerging questions and procedures (Khaldi, 2017). I chose the qualitative method for this study because it allowed me to explore the experiences of HCI developers to gather strategies to help other HCI developers who seek to develop accessible websites for older adults over 65. When collecting numerical information, a quantitative study approach is used (Neuman, 2014). Researchers who conduct quantitative studies form hypotheses on the relationships between variables and use statistical comparisons to formulate a scientific outcome (Cameron et al., 2015). I did not use a quantitative approach in this study because numerical information was not collected or used. I did not seek to form hypotheses on the relationship between variables. A mixed-method approach combines quantitative and qualitative methods (Kamalodeen & Jameson-Charles, 2016). This approach allows researchers to use the statistical analysis of vast sample sizes and simultaneously combine it with a qualitative approach

to reaching participants (Stockman, 2015). In the current study, I did not use quantitative methods and only sought to utilize the qualitative approach. Hence, a mixed-method approach was not appropriate to achieve the study's goal.

I employed an exploratory multiple-case study design in this study. A case study is often used in studies to allow the researcher to investigate a phenomenon with a bounded context from various perspectives to gain in-depth details about that phenomenon (Taylor & Thomas-Gregory, 2015). The phenomenon under study was HCI web developers' lack of design strategies to create websites for older adults. Qualitative studies have four standard designs in an interactive and noninteractive way: narrative, case study, ethnography, and phenomenological (Kruth, 2015). I chose a qualitative multiple-case study design because it allowed me to gain in-depth details about participants' strategies to create accessible websites for older adults over 65.

When using a narrative inquiry, a researcher seeks to understand the experience of an individual's life and express such findings in the form of storytelling or biography (Bell, 2011). I did not use a narrative inquiry design in the current study because I did not seek to understand an individual's life in the form of an autobiography or biography, trying to find out how that individual's life experience could change or form a theory. An ethnographic design is used to describe and interpret the shared patterns of the culture of a group and draws from the discipline of anthropology and sociology (Khan, 2014). An ethnographic design was not used in the current study because my goal was not to study culture group patterns. Kruth (2015) described a phenomenological design as focusing on understanding the principles of a lived phenomenon, and the design draws from the

disciplines of philosophy, psychology, and education. I did not use a phenomenological design in the current study because my focus was not on a phenomenon's lived experience but on developing a detailed analysis of one or more cases based on a phenomenon. I investigated the strategies HCI web developers use to create accessibility options for older adults over 65; therefore, a multiple case study design was most suitable for this study.

### **Research Question**

What strategies do HCI website developers use to build HCI interfaces to meet accessibility requirements for older adults over 65?

### **Interview Questions**

I asked the following interview questions to gather information to answer the research question of the study:

1. How long have you worked in this role in designing and developing HCI websites that provide accessibility for adults over 65?
2. Do you have a standard of design when designing HCI interfaces to meet accessibility for adults over 65?
3. What is your focus on creating unique options in terms of frontend interaction for adults over 65?
4. What requirements do you consider before designing a website for adults over 65?
5. How do you test your accessibility options to be HCI-compliant for adults over 65?



6. How do you gather feedback from adults over 65, and how does feedback play a part in your updates?
7. What type of HCI accessibility options focus on adults over 65?

### **Conceptual Framework**

The technology acceptance model (TAM) was used as the conceptual framework of this study. TAM was established by F. Davis (1985) to create a way for developers and designers to test the user acceptance of information systems. In TAM, F. Davis created two primary constructs to measure the user acceptance aspects of using technology systems: perceived ease of use (PEOU) and perceived usefulness (PU). After the creation of the TAM model, technology systems evolved to include more elements for users to interact with, and testing for PEOU and PU was not enough measurement to see if user effectiveness in technology systems would be 100% (Venkatesh et al., 2016). The TAM model was extended to TAM2 in 2002, the unified theory of acceptance and use of technology (UTAUT) in 2003, and TAM3 in 2008 (M. D. Williams et al., 2015).

Previous studies have used some form of the TAM to test PEOU and PU to measure the acceptance of technology by individuals and organizations (M. D. Williams et al., 2015). In the current study, I used the TAM as the lens through which to question web developers on what strategies they use to build websites for older adults over 65. The PU and PEOU constructs aligned with the research question in helping me determine how web developers create websites for older adults over 65.

### **Definition of Terms**

*Baby boomers*: People born between 1946 and 1964 (Mitzner et al., 2016).

*HCI*: A study of the design and use of computer technology that focuses on the interfaces and interactions between people and computers (Gitlow, 2014).

*TAM*: A model used to test software on usefulness before going into production (F. Davis, 1985).

*PEOU*: The construct defined by F. Davis (1985) to measure the step to which a user expects the target technology to be free of struggle.

*PU*: The construct defined by F. Davis (1985) to measure behavioral intentions of the user's use of technology.

*Theory of reasoned action (TRA)*: A theory used to identify how a person adopts a given behavior based on prior intentions and beliefs (Ajzen & Fishbein, 1977).

### **Assumptions, Limitations, and Delimitations**

#### **Assumptions**

Assumptions are beliefs that, when accepted as the truth and if unconsciously carried out, may lead to biases in the form of perception and cognitive manner (Walsh, 2015). The first assumption was that the number of participants selected was sufficient to reach data saturation. The second assumption was that participants knew about HCI website design and could answer the interview questions.

#### **Limitations**

According to Busse et al. (2016), limitations threaten the validity of a study and are theoretical and methodological imperfections that may be unforeseen by the researcher. One limitation of this study was that in doing a multiple case study, I was limited to how many organizations I could use in the study. The study was also limited to

organizations in one state in the United States, and this may have potentially omitted states in which knowledgeable website designers who have strategies to create HCI websites for older adults over 65 reside.

### **Delimitations**

Delimitations allow the researcher to keep within the study's boundaries and scope and not use irrelevant data or participants (Busse et al., 2016). The first delimitation was that the participants were from organizations in the private sector and not from the government sector. The second delimitation was that participants had to be knowledgeable of the HCI website design for older adults 65, so the search for participants was limited to that group. The third delimitation was that the organizations were only website design organizations, not general computer ones.

### **Significance of the Study**

#### **Contribution to IT Practice**

Technology has evolved exponentially, and citizens who are not computer savvy face challenges while interacting with devices to access information on the internet (Leitner et al., 2016). Luna-García et al. (2015) noted that while technology improves people's daily lives, older adults over 65 have accessibility problems using the internet. Luna-García et al. found that the experience of older adults over 65 using technology improves through training; however, the researchers noted a lack of information on designing accessible websites. This study may offer a fundamental starting point for designers and developers of websites to easily incorporate accessibility strategies in creating accessible websites to promote technology acceptance, use, and adoption among

older adults over 65. This study contributes to IT practice by potentially providing a strategic design plan for developers to follow when creating websites that cater to older adults over 65.

### **Implications for Social Change**

In this study, I aimed to identify and understand the strategies HCI web developers use to design and build websites that accommodate the internet interactivities of older adults over 65. The study findings may result in improved websites that are easier for older adults. This study may contribute to social change by providing benefits to older adults by opening up their world by allowing them to connect with their families through distance communication and creating another avenue for health providers to contact them.

### **A Review of the Professional and Academic Literature**

This qualitative multiple case study aimed to explore the strategies for developing websites in HCI for older adults over 65. My focus in this review of the academic literature was to discuss the TAM as the conceptual framework for this study and then provide background on developing websites in HCI for older adults over 65 while relating the extant literature to the central research question: What strategies do HCI website developers use to build HCI interfaces to meet accessibility requirements for adults over 65? The review of the literature addresses the following topics that were significant in answering this research question: the TAM, how creating HCI websites for older adults over 65 is an applied IT problem, how HCI websites for older adults are defined and explained, challenges older adults face when using everyday websites, and

strategies HCI developers use for developing websites. Other subthemes that arose throughout the literature surrounding HCI design for websites included the benefits and barriers to using official websites that support older adults over 65. The primary and secondary themes are broken down to relate to the research question.

This academic literature review comprises 100 journal articles on developing HCI websites with the TAM as the foundation. Of the articles included in the study, 88% were published within five years of my anticipated graduation date (i.e., between 2018 and 2023). I verified the peer-review status of these articles by using *Ulrich's Periodicals Directory*. Of the 100 articles, 88% are peer-reviewed, and 85% were published within four years of my anticipated graduation in 2023. These journal articles were primarily retrieved through databases available through the Walden University Library, such as IEEE Xplore Digital Library and ProQuest, the Google Scholar search engine. CrossRef was used to verify the DOI information of references. I used the following keyword search terms: *technical acceptance model, TAM, TAM2, TAM3, HCI, older adults using technology, HCI designers for older adults, seniors, and computers, website design for older adults, website usage and the more aging population, and computer challenges older adults to face*.

## **TAM**

The TAM is a framework developed to envision the acceptance and adoption of new technology by end-users (F. Davis, 1985). There are two essential constructs in TAM, PEOU, and PU, with PEOU referring to how easy it is to learn and use a system and PU emphasizing whether the user believes the plan would enhance their performance

(F. Davis, 1985). In this study, I used the TAM as a foundation to potentially provide strategies for developers to follow when creating websites that cater to older adults' PU and PEOU. The TAM provided me with the lens to determine the strategy that will help HCI website developers develop accessible websites for older adults over 65.

### ***The Evolution of the TAM***

The TAM provides a valuable and reliable indicator that envisages the acceptance or adoption of new technologies by end-users (F. Davis, 1985). F. Davis developed the TAM based on the TRA because there was no form of measurement to test acceptance by users for developers to determine what corrections to make before fully applying a new technological concept or product. There were many conceptual models available that could have served as a foundation for this study. Still, I chose the TAM because it helped me discern the reasons for the acceptance of technology by an individual.

(F. Davis, 1985) first proposed TAM in 1985 in partial fulfillment of a Ph.D. The purpose of TAM was to explain the determinants for technology acceptance, which explain users' behaviors. F. Davis developed the TAM by adopting the concepts of the TRA), a general social-emotional/behavioral theory that had been proven helpful in understanding various behaviors. According to Ajzen and Fishbein (1977), the TRA indicated that a person's behavioral intention to perform a meant feat is influenced by the person's attitude toward the behavior in combination with the subjective norm regarding the action.

To comprehend the TAM, the essential concepts of the TRA must first be understood. The TRA was created in 1967 by Fishbein (1967) and later tested and refined

by Ajzen and Fishbein (1977). The TRA was developed to explain the relationships between attitude, beliefs, intention, norms, and behavior. The TRA envisages and comprehends an individual's behavior by considering the effect of personal feelings (i.e., attitude) and perceived social pressure (i.e., subjective norm). In the TRA, it is theorized that beliefs influence attitudes, leading to intentions and generating behavior. Ajzen and Fishbein noted that the TRA is said to be one of the underlying theories in psychology that predict behavior and give a better understanding of the relationships between intentions, attitudes, and behaviors.

Technology now supports many day-to-day activities (Geraedts et al., 2014; Kernisan, 2016; Van Zaalen et al., 2018; Wang et al., 2018). The TAM will play a vital role in helping older adults to adapt to technology, although they tend to be reluctant to do so (Geraedts et al., 2014). In the TAM, it is assumed that when users recognize that a type of technology is beneficial and has ease of use, they will be more enthusiastic about utilizing it (F. D. Davis, 1989). The TAM explains the influences of new technology acceptance by explaining the users' behaviors (Chiu & Liu, 2017; F. Davis, 1985; Zamani & Shoghlabad, 2017). (Chiu & Liu, 2017; F. Davis, 1985; Zamani & Shoghlabad, 2017) focused on two essential factors influenced by external variables relevant to computer use behaviors: PU and PEOU. F. Davis defined PU as the likelihood that using a specific application system will enhance a future user's job or live performance. Conversely, the definition of PEOU is the degree to which the potential user expects the target system to be user-friendly. External factors are present using the

TAM, and the external factors in PU and PEOU are cultural, social, and political (F. Davis, 1985).

In the digital world, technology continues to evolve; through this evolution, millions of potential users connect daily. With this progression, adults 65 and older have become a population group of concern because this group has the most reluctance to accept technological change. Therefore, creating F. Davis's TAM empowered other researchers to delve more into the user/users' acceptance of the technology. The lack of acceptance of technology often stems from fear and anxiety (F. Davis, 1985).

### *Analysis of Similar Theories*

Multiple extant theories similar to the TAM have the same objectives, such as the ecological and unified theory of acceptance and use of technology (UTAUT).

**Ecological Theory.** Lawton and Nahemow (1973) used ecological theory to explain older adults' interactions with their environments. According to the authors, ecological theory defines aging as a transactional process of continual adaptation to the external environment, internal capabilities, and functioning. They presented the theory as having five components as factors to determine adaptation to environmental changes, including technology: individual competence, environmental press, adaptive behaviors, affective responses, and adaptation level (Lawton & Nahemow, 1973). Although the ecological theory is like TAM in the form of user adaptation, it contrasts with individual competence as one of the critical components.

**UTAUT.** Venkatesh et al. (2003) combined the TAM and theory of planned behavior into the UTAUT. In the UTAUT, they identified the four key factors of



performance expectancy, effort expectancy, social influence, and facilitating conditions along with four moderators: age, gender, experience, and voluntariness related to predicting behavioral intention to use technology and actual technology used primarily in organizational contexts. In the UTAUT, Venkatesh et al. found that performance expectancy, effort expectancy, and social influence influenced behavioral intention to use technology, while behavioral intention and facilitating conditions determined technology use. Although similar, the TAM's constructs of PU and PEOU were more appropriate as a framework to answer the research question of the current study and gather the strategies for HCI web developers.

### ***Analysis of Contrasting Theories***

The cognitive dissonance theory (CDT) and social cognitive theory contrast with the TAM. The TAM uses PU and PEOU to verify users' adaptation to technology before production, while these theories predict usage over time.

**CDT.** The CDT was framed by Festinger and Pepitone (1959) to describe how inconsistencies between one's cognition and reality change the person's subsequent perception and behavior (Bhattacharjee, 2001). This theory depicts a process model of individual behavior whereby users form an initial pre-usage belief about technology, experience its usage over time, and then form post-usage perceptions of the technology. The dissonance between users' original expectations and observed performance is captured in the disconfirmation construct (Bhattacharjee, 2001).

The standards of the CDT have been proven as more relevant to form technology acceptance through a few studies in literature (Bhattacharjee, 2001; Bhattacharjee &

Premkumar, 2004). Those aspects do not appear to suitably direct most of the technology acceptance studies, and they have not received the same level of attention in the available literature as the TAM in technology acceptance. The CDT has not been researched in various contexts in technology acceptance.

**Social Cognitive Theory.** Bandura developed the social cognitive theory of human functioning, describing how people are actors and products of their environment (Luszczynska & Schwarzer, 2005). According to the social cognitive theory, behavioral change is made possible by a personal sense of control (Luszczynska & Schwarzer, 2005). The theory suggests that human motivation and action are regulated by forethought, which anticipates a control mechanism that involves expectations that might refer to outcomes of undertaking a specific activity (Luszczynska & Schwarzer, 2005). The theory outlines several crucial factors that influence behavior (i.e., perceived self-efficacy, goals, and behavior), which are concerned with people's beliefs to attain the desired outcome (Luszczynska & Schwarzer, 2005). This theory contrasts with the TAM because the TAM focuses on users adapting to technology by using the constructs of PU and PEOU. Luszczynska and Schwarzer (2005) suggested that varying levels of expertise among older adults are distinct domains, such as cognitive abilities, physical health, psychological adjustment, and other qualities. The TAM uses PU and PEOU to measure user adaptiveness, which was more appropriate for the current study.

### ***The Use of the TAM by Researchers in the Field***

Many researchers in various fields of study have used the TAM to determine users' acceptance of newly created technology. Suresh et al. (2016) employed the TAM to

understand factors that affected the acceptance of an outpatient information system in the private hospital sectors in Chennai City. The authors used the TAM constructs of PEOU and PU as variables in the study and customized information and trustworthiness as additional external variables. The authors suggested that using TAM and the abovementioned other variables directly or indirectly affected the level of information secured via social media use by out-patients acceptance of technology in the private hospital sectors.

Because the TAM is one of the more proficient models for measuring technology adoption, many researchers use it. Roy (2017) utilized the model to investigate users' internal motivations, perceptions, and adoption mechanisms concerning app-based cab services in the metropolitan setting of Kolkata, India. One of the main reasons for selecting the town of Kolkata as the sampling frame for the study was the advantage offered by these ride-sourcing services over the quintessential yellow taxis in the city. The application allowed commuters to expediently access taxi information using their smartphones, including the details about the cab and its driver, thereby controlling the irregularity between passengers and drivers and improving the efficiency of hailing a cab. Sheng and Zolfagharian (2014) also utilized the TAM in a study on consumer participation in online product recommendation services. They examined the problematic role of consumer participation by empirically testing a theoretical model within the online context of the consumer using product recommendation agents (RAs) that assimilate consumer participation into the TAM. Recent research has questioned whether consumer participation is a double-edged sword, although its positive effects are in the services

marketing literature. Their study demonstrated consumer participation's dual effect and acknowledged financial risk as a mediator of consumer participation's adverse outcomes. The authors asserted that future research could employ a different design, such as using controlled lab settings.

As stated by Peek et al. (2016), the baby boomers are a generation that wants independence, which begins with them remaining in their own homes and often in the communities that they have grown accustomed to. In a technological era, technology will undoubtedly play a vital role in achieving that goal. Peek et al. established that older adults prefer to age in their familiar environment. There are policies in place to support them remaining in their own homes and communities, saying that "Technology can play a role in staying independent, active and healthy" (para. 1). In their qualitative, explorative field study, the authors concentrated on home visits to 53 community-dwelling older adults between the ages 68–95 years old. Subjective sampling was used to include participants according to their living arrangements, different health statuses, and levels of technology experience. Detailed information was also gathered on participants' chronic illnesses, fragility, personal health, perceptible functioning, major life events, and their ownership of and ability to use technology. Peek et al. stated, "The study was designed to include various types of technology that could support activities of daily living, personal health or safety, mobility, communication, physical activity, personal development, and leisure activities. Thematic analysis was used to evaluate interview transcripts" (para. 3). The authors concluded that older adults' perceptions and use of technology are entrenched in their social, personal, and physical background; therefore, to support aging

in place using technology, contextual and psychological factors are needed (Peek et al., 2016).

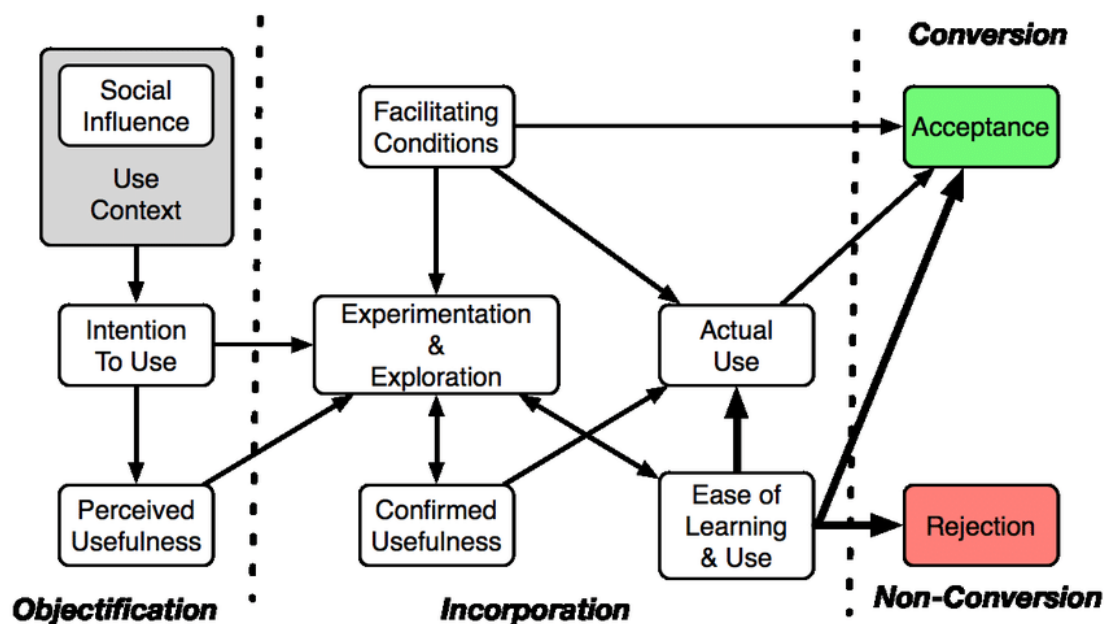
Along with the TAM and TRA, researchers have developed other models over the years, but the TAM continues to be an extension of different models. The senior technology acceptance model (STAM) is an extension of the TAM. According to Wang et al. (2018), the STAM is one of the few technology acceptance models concentrating on older adults and general gerontechnology. Wang et al. (2018) stated factors impelling technology acceptance are individual attributes, such as gender, age, education, gerontechnology anxiety, and self-efficacy. Health and ability characteristics and facilitating conditions are vital (p. 4). Wang et al. recommended that psychological, physical, and social characteristics associated with aging may affect how an older adult interacts with technology and devices.

Wang et al. (2018) developed and tested the STAM aimed at older Hong Kong Chinese people's acceptance and comprehension of gerontechnology. Gerontechnology is defined as the interdisciplinary field of scientific research where technology is focused on the opportunities and objectives of older persons. The proposed STAM extended previous technology acceptance models and theories by adding age-related health and the ability characteristics of older people. STAM was empirically tested using a cross-sectional survey with 1,012 seniors aged 55 and over in Hong Kong. The results showed that the STAM was strongly supported by 68% of the variance in gerontechnology use. For older Hong Kong Chinese people, individual attributes, including age, gender, education, health, ability characteristics, and most importantly, gerontechnology, self-efficacy,

anxiety, and enabling conditions overtly and directly affected technology acceptance. These were better prognosticators of gerontechnology usage behavior than the conservatively used attitudinal factors (i.e., usefulness and ease of use). Figure 1 illustrates the STAM.

**Figure 1**

*The Senior Technology Acceptance and Adoption Model*



*Note.* From “Predicting Technology Acceptance and Adoption by the Elderly: A Qualitative Study,” by K. Renaud, & J. Van Biljon, 2008, *Proceedings of the 2008 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries: Riding the Wave of Technology* (pp. 210-219). Copyright 2008 by ACM. Reprinted with permission (see Appendix B).

### *The Utilization of the TAM in This Study*

TAM was used in the research with two prioritized TAMs-Almere and the senior technology acceptance model (STAM)-recognizing the adoption and use of assistive robots by older (Shore et al., 2018). The TAM model evaluates and assesses e-information services for information research, such as e-library services (Shore et al., 2018). Furthermore, user satisfaction, free access, information architecture, content richness, policies and rules, publishers' quality, system self-efficacy, and task-technology fit were incorporated into the TAM to extend it with other factors theoretically motivated and would be of interest more generally (Barhoumi, 2016). Key parameters were identified to integrate the technology acceptance model (TAM) and technology-organization-environment framework for firm-level technology adoption (Barhoumi, 2016). This integration is intended to improve the predictive power of the resulting model.

The examination of consumer cooperation explores a theoretical model where the customer uses consumer participation integrated with recommendation agents (RAs) within the (TAM). The results lead to consumer participation positively affecting enjoyment, while perceived ease of use of an RA is negatively influenced. Using a selection of TAMs, displaying a chronology that highlights their evolution, and two prioritized TAMs -Almere and the (STAM)-that merit consideration when attempting to understand the acceptance and use of assistive technology (Shore et al., 2018).

## **Human-Computer Interaction (HCI)**

This section will cover how computers have expanded to include multiple devices such as mobile phones, tablets, GPS, and laptops that interact with people. According to Pittarello and Pellegrini (2017), Purkait et al. (2019), and Gulliksen (2017), human-computer interaction is the study of how people interact with computers. Pittarello and Pellegrini explained that people today interact with computers via hardware and software interfaces. Keyboards, keypads, touch screens, browsers, and phone apps are hardware and software interfaces people use to interact with the computer. People sometimes face HCI challenges using these interfaces because of design inconsistencies (Nielsen, 1994). However, because of their reluctance to try these modern technologies, seniors face even more challenges than the younger generation. McMurtrey et al. (2011) asserted that conservative understanding promoted this divide and suggested that older adults may be unable to operate technology. Their disinclination of change restricts technology adoption and technology that is for a younger generation. These researchers suggested that technology, from computing to cell phones, was not designed for older adults.

Nielsen (1994) evaluated how people interacted with computers and initiated ten general principles that designers of interfaces should consider when designing interfaces for interaction. These principles guiding interface designers on compliance with HCI are called usability heuristics. Nielsen's ten principles are:

- Visibility of system status – through feedback, this system should keep the user informed of what is going on with appropriate input and promptly.



- Match between the system and the natural world – this system should use words and language the users are familiar with, making the interaction natural to the users.
- User control and freedom – this system should give the users a way out, allow for easy exits, and include redo and undo.
- Consistency and standards – actions and words should be consistent throughout, allowing users not to wonder if words and actions have the same meaning.
- Error prevention – this system should have a way to capture errors or problems and lead the users out or handle the error.
- Recognition rather than recall – this system should memorize users' actions so that users do not have a heavy burden of remembering.
- Flexibility and efficiency of use – this system should allow users to tailor frequent actions; Aesthetic and minimalist design should not have irrelevant or rarely used dialogue.
- Help users recognize, diagnose, and recover from errors – this system should have error messages and help messages in plain language to be easily understood.
- Help and documentation – this system should be accessible and not too giant (Nielsen, 1994).

Designers still use these principles when designing interfaces that computer users interact with (Datta et al., 2019). There are other rules that designers go by when creating

and developing user interfaces that interact with computers. These principles can guide web designers to develop "easy to use" internet and web access for older adults who are often left behind in this technological evolution (Datta et al., 2019). In their forums, the authors emphasized the “failure of co-design, where they explained that seniors should be part of the designing process for technology for their use.” (Para. 4).

“Seniors feel that young designers and technicians don’t understand their manual issues with technology use, an intergenerational issue. For example, some do not intuitively understand the connection of the mouse with the cursor on the screen and, more generally, the virtual world, which fits a prevention model where one works upstream to stop the problems occurring rather than downstream after it has” (pg. 12).

HCI rules for interface design, like Nielsen’s 1994 principles, were also initiated by Shneiderman (2004). These rules are (a) Strive for consistency, (b) Seek universal usability, (c) Offer informative feedback, (d) Design dialogs to yield closure, (5e Prevent errors, (f) Permit easy reversal of actions, (g) Keep users in control, and (h) Reduce short-term memory load (Aottiwerch & Kokaew, 2017). Nielsen’s 1994 principles and Shneiderman's user interface rules have the user in mind. Adhering to the eight rules of interface designs by Shneiderman will allow for user-friendly interfaces for seniors. How the user interacts and reacts to the interface plays a role in their ease of use in their behavior towards technology (Aottiwerch & Kokaew, 2017). Hornbæk and Hertzum (2017) explained a relationship between HCI and TAM, where their behavior and feelings influence human interaction with a computer.

## **HCI and TAM**

As technology continues to evolve, older adults sixty-five and over have the most difficulty accepting and accessing the modern way of communication and, therefore, lack the technology perception (Geraedts et al., 2014). Using today's technology can help this group of the population in their daily activities. Vaportzis et al. (2017) affirmed that today's technologies support many daily activities. Geraedts et al. (2014) explained that continued technological development has occurred alongside the aging of global populations and created opportunities for technology to assist older people in their everyday tasks and activities, for example, connecting with friends, financial planning, and family.

Geraedts et al. (2014) explained that new technology could provide timely interventions to support adults in keeping healthy and having continued independence. Given the drawbacks of this population, it is crucial to study how they would accept interaction with the Internet. Computers are used to communicate by sending emails, video conferencing, using chat forums, and exchanging and sharing photos. Aging adults use this medium and the technology provided to communicate with their loved ones to maintain and develop relationships (Burnett et al., 2011). Therefore, knowing how to use the internet plays a role in the usefulness or success of aging adults as they try to access this form of technology in their day-to-day lives (Burnett et al., 2011). The authors examined a computer's usability factors related to the aging community in their article. It explored the older adult's perception of the technologies used to communicate over the computer medium due to the evolution of computer technology. By showing that older

adult's use of the computer is mainly for internet use, the article included research that examined the data of the percentage of older adults that do use internet technology.

The Pew Internet and American Life study explained that 58% of older adults between 65 and 73 and 30% of adults over 74 go online. Of this sample of older adults, 90% and 88% (respectively) use the Internet for email (Zickuhr, 2010). Although many older adults use the internet to communicate, many are nonusers. The authors also examined the quality of life of older adults and how it may affect their use of computers for sharing activities. A study was done to explore some of the reasons why there were computer technology nonusers of the communicating tool (Zickuhr, 2010). Selwyn (2004) explained why some older adults did not use computer technology. The author also examined variables associated with older adults' belief that a computer helps perform communication-related activities (HCI). The article focused on the relationship between the perceived importance of communication activity and the perceived usefulness of computers for that activity (TAM). The researcher used 321 older adult participants.

A questionnaire was used. (57% female) between the ages of 60 and 93 ( $M = 74.62$ ;  $SD = 5.98$ ) returned questionnaires for this study. The respondents were drawn from databases of older adults residing in two southeastern cities and reported to be in good health. A total of 662 questionnaires were mailed (with 15 returned as undeliverable), and 321 were returned, yielding a response rate of 49.6%. Of the respondents, 281 reported themselves as computer users and were included in the present analyses. The specific computer communication characteristics asked for were emailing

photos, mass emailing, emailing videos, instant messaging, forums, social networking, video conferencing, chat groups, and dating websites. The survey of older adults shows that prior experience and the perceived importance of activity for one's quality of life are strong predictors of the perception of the usefulness of a computer for communication activities (Selwyn, 2004).

It is important to examine HCI research concerning the (TAM). The (TAM) outlines the effects of system design characteristics (functionality and interface features), through perceived ease of use and apparent usefulness, on people's intentions to utilize the system (F. Davis, 2015). TAM's purpose is to foresee and explain user acceptance of new information systems based on the assessed intended usage of potential users after a short trial experience using an archetype of the system. TAM extends traditional user interface testing procedures, accentuating objective usability benchmarks (e.g., performance times and error rates) (F. D. Davis, 2015). HCI focuses on the best ways to design the user interface to improve system performance. In contrast, TAM enhances people's willingness to use a system. Given that user acceptance and task performance are crucial to the success of a system, TAM and HCI present complementary points of view (F. D. Davis, 2015).

### **Application to the Applied IT Problem**

TAM, which is globally accepted, is vital to this study since the elderly population is believed to be the fastest-growing in the 21st century. There is also a reluctance for this group to embrace technology. According to Chiu and Liu (2017), Pikna et al. (2018), and Li and Luximon (2019), the implementation and adoption of computer technology and the internet prove more difficult for this group to access.

**Older Adults and Their Use of Technology.** TAM, like technology, has evolved, and while the younger generation has caught on to the digital trend, the elderly population must be guided in these directions. It is estimated that globally, 8.5 percent of the population (617 million) are 65 years and over (National Institute of Health, 2016). Therefore, this population group must be exposed to new technology as it would positively affect their daily lives.

Because the aging population is growing alongside this technological evolution, it creates opportunities for technology to assist older adults in everyday tasks and activities. These daily activities include connecting with family and friends and financial planning. New technology can also provide timely interventions to assist older adults in staying healthy and independent (Geraedts et al., 2014).

Barbara et al. (2018) averred that adults 65 and over, compared to other age groups, are less likely to access the Internet, although their usage is increasing. The authors explained that exploring the societal effects of internet usage is using social capital as an analytical tool. Social capital is a resource potentially available in one's social ties. The study also noted that as the Internet becomes a prominent source of

communication, information, and participation in developed countries, it is critical to study how it affects social resources from an age-comparative perspective (Barbara et al., 2018). To accommodate older adults with little to no technical skills, F. Davis's TAM allows this group of the population the opportunity to understand and accept technology.

**Internet adoption by older adults.** Older adults over 65 rapidly use technology to carry out their everyday living. According to Lee and Coughlin (2015), ten factors influence older adults' use of technology: value, affordability, usability, technical support, social support, accessibility, emotion, confidence, independence, and experience. They found that these factors affect how older adults adapt to using technology. Managing the ten aspects may control the positive outcome of how older adults use technology. Technological adoption among older adults is on the rise, and finding ways to control how they perceive a positive impact can be achieved. HCI website developers can use these ten factors to guide them in creating accessible websites for older adults (Lee & Coughlin, 2015).

Zheng et al. (2015) conducted a study where 395 older adults participated, and the researchers found factors that influence older adults' internet use. Some factors were social connection and seeking health and financial information. This finding supports that older adults use the Internet and validates their perception of using the Internet. HCI web developers could use this information to build websites for older adults. Considering the trends in the adoption of technology by age can be informative. Vaportzis et al. (2017) found that older adults are slower to adopt new technologies than their younger counterparts. However, it is also noted that older adults are more likely to adopt if they

deem the technological advancement to add value to their lives (Vaportzis et al., 2017). Older adults principally utilize technology to preserve their quality of life as they age, stave off social isolation, and maintain contact with family (Guo, 2017). For technology to be made more user-friendly to older adults, understanding what they perceive as the advantages and disadvantages of its use can provide insight into how to use technology.

Today's health technologies allow healthcare consumers to interact with technology to encourage educated decision-making and healthy behaviors (Currie et al., 2015; Czaja, 2015; Greenwald et al., 2018; LeRouge et al., 2014). Even though older adults are slower to adopt new technology, they have shown a vested interest in technology when it concerns their healthcare. A study by Greenwald et al. (2018) showed that the satisfaction and quality assessment scores among older patients were comparable to those of younger patients regarding health telecommunications. The authors found that older adults demonstrated flexibility and interest in utilizing technology for healthcare purposes.

Research by Myhre et al. (2017) found cognitive benefits of social networking for older adults. The authors found that social interaction is a factor in an individual's lifestyle that may play a vital role in their mental acuity. Furthermore, the age-related changes in cognitive ability that transpire can harm computer use and technology adoption. The influence of cognitive impairment on web usability was analyzed. It was determined through these human-interaction studies that utilizing social media and other online interactive technology can significantly benefit older adults (Haesner et al., 2015; Marchibroda, 2015; Marzano et al., 2016).



**Technology Challenges Faced by Older Adults.** Baby boomers now make up a significant portion of the population, and since technology has evolved, older adults must become more familiar with this modern way of communicating. Adapting to the digital way of life is advantageous as it promotes independent living (Bowles et al., 2015; Schmidt et al., 2014). Technology has made the day-to-day activities of the population more efficient. Schmidt et al. (2014) asserted that technological changes in society and the potential of technology to support older adults have recently attracted much attention. The authors explained that user-friendly technologies might facilitate daily living activities for physically frail individuals with cognitive impairment. The authors assessed the performance of older adults without perceptible impairment ( $n = 27$ ) and mild cognitive impairment ( $n = 26$ ) using three types of technology. Relationships between performance in the technology-based tasks and cognitive abilities (e.g., visual-spatial abilities), personality characteristics (e.g., self-efficacy), and previous technology experience were examined using a mixed-methods approach, including video analyses and psychological testing. Principally, the growth in the utilization of the Internet has made it vital to people's everyday lives (Dupuis & Tsotsos, 2018; McSweeney-Feld, 2017; Piraino et al., 2017; Vaportzis et al., 2017;). The convenience of online banking, shopping, healthcare services, education, and social networking is what has driven the Internet's progression (Kisekka et al., 2015; Moulton et al., 2018; Vaportzis et al., 2017; Wion & Loeb, 2015). The aging population must also make these online services more accessible to older adults (Vaportzis et al., 2017).

There are various procedures and guidelines for public and private organizations regarding website usability and accessibility. Many of these standards addressed the technology accessibility concerns of people with disabilities (Arfaa & Wang, 2014). Although older adults and people with disabilities cannot be considered the same, many of the technology usage issues that older adults face are because of disabilities associated with aging (Arfaa & Wang, 2014). The goal of web accessibility is to enable websites to be more usable and user-friendly to the disabled and other users who may have impairments affecting their use of websites (de Lara et al., 2016). All older adults may not necessarily use all the same accessibility technologies that users with disabilities do. Still, the mechanisms that are already in place can assist those with declines related to age access to some sites (de Lara et al., 2016). Technology and website mechanisms must be geared explicitly to older adults and their needs (de Lara et al., 2016; N. L. Hill, 2017; Kang et al., 2019).

In a 2015 review, Shelton and Uz asserted that technologies providing more immersive experiences to users had become more universally utilized by people of all ages. The authors investigated the current state of the research about older adults and the use of immersive technologies. The review also analyzed how immersive technology environments affected older adults' age-related deteriorations, including sensory and motor declines (vision, hearing, motor skills), cognitive declines, and social changes (Shelton & Uz, 2015). Older adults tend to be disparate and diverse groups concerning their utilization of technology because of their diverging motivations, current knowledge, and previous employment (Lee & Coughlin, 2015). Additionally, while many older adults

have made strides in embracing the use of technology, some others are more reticent, which is why it is important to take strides in making technological ease of use a focal point in digital and website development (R. Hill et al., 2015).

Although the rate of adults making their lives more digitally inclusive climbs higher, many remain disconnected. According to the Pew Research Center (2017), one-third of adults aged 65 and older state that they never use the Internet, and nearly half state that they do not have Internet service at home. There are generational differences within this cohort, as well. Younger seniors (ages 65-69) are more likely to have adopted newer technologies than older seniors (75 and older) (Pew Research Center, 2017). Many factors play a role in older adults' sluggish rate of technology acceptance. Lack of experience, skills, awareness, and confidence in their ability to utilize new technology to access the internet and perform everyday tasks online can be barriers. Declining physical health and mental acuity are barriers (Mubarak & Nycyk, 2017). Many older adults also need someone to show them how to use new devices or navigate different sites online (Mubarak & Nycyk, 2017). Pew Research Center found that once older adults are online, they engage at high levels, and the internet becomes part of their daily routine. They acknowledge the positive impact that adopting technology has on them and society.

The willingness of older adults to adopt technology is closely linked to the technology's perceived value, the effect on one's quality of life, accessibility, and comfort and confidence in learning the technology (Berkowsky et al., 2017; Carolyn et al., 2018; Walsh et al., 2018). To increase the usage and adoption of technology by older

adults, developers must be cognizant of the barriers that may keep them from embracing technology (Berkowsky et al., 2017).

**The generation gap in using technology.** As age diverges, so does the likelihood of making different choices regarding accepting and utilizing technology. Usage rates of smartphones, computers, tablets, and other technologies differ between the generations (Niehaves & Plattfaut, 2017). The difference in technology usage between the ages is known as the “digital divide” (Niehaves & Plattfaut, 2017). The digital divide concerns the generational gap present in the usability and accessibility to new interactive and information technologies (Magsamen-Conrad et al., 2015). Among older adults, there can be wariness and anxiety in adopting and using new technologies that aren't present in younger generations. Magsamen-Conrad et al. (2015) examined research concentrating on cognitive and physiological factors that may lend themselves to the generational divide and ascertained that the older generation's use of technology is significantly impacted by concerns like the "perceived requirements" for adopting and using new technologies.

Each generation's comfort level is also an essential factor that can influence the use of technology. Older adults tend to be less comfortable or at ease when using technology and lack confidence in their capability to utilize technology well (Magsamen-Conrad et al., 2015). Older adults are known not to be as interested in adopting newer technology as younger generations and expressed more reluctance (Magsamen-Conrad et al., 2015). Younger adults are more accustomed to ever-changing technologies and are more curious to learn about them in a way that older adults are not (Magsamen-Conrad et

al., 2015). Understanding all the factors that predict older adults' use and adoption of technology is imperative to facilitate accessibility and ease of use more tailored to them.

**Use of Technology Among Older Adults.** For older adults, technology can play a vital role in preserving some independence, staying socially connected, and maintaining an active and healthy lifestyle. However, technology use fluctuates noticeably among this cohort (Vroman et al., 2015). Older adults regularly use long-standing technologies that have been around for a while but are more sluggish when adopting new ones (Wu et al., 2015). Older adults have less access to and use more modern technologies than younger adults. They tend to be more traditional, distrustful, wary, and risk-averse than their younger counterparts. Seniors are more apt to adopt an innovation after observing that others have effectively utilized the technology in their social sphere. They can see the value of it for themselves (Wu et al., 2015).

A socio-ecological model of older adults' technology use with the individual at the center with their distinct traits comprising attitude toward technology, needs, and their ability to utilize digital technology was proposed by Vroman et al. (2015). The subsequent tier of technology use is a means of performing day-to-day activities. The last tier denotes the highest level of digital connection with the individual, creating relationships with their community, which is not contained by geographical limits. The speculative model suggested by Vroman et al. is derived from quantitative analyses, which may not completely capture the experiences of older adults. Mainly, older adults are a distinct and varied group in their use of technology because of their varying motivations, existing knowledge, and employment history (Lee & Coughlin, 2015).

Although some seniors have enthusiastically adopted innovations, others are more hesitant, resulting in a developing digital divide among the cohort (R. Hill et al., 2015).

The rapidly rising societal digitalization of society has been acknowledged as a cause of lessening social interaction because of the decrease in face-to-face communication that it enables; however, digital technologies may aid in staving off the social isolation prevalent among older adults (Wang et al., 2018). For instance, seniors with limited mobility can utilize technology to sustain their social contacts and eventually aid their well-being by enhancing their understanding of health issues (Tennant et al., 2015).

Older adults use the Internet, and although evidence points out that they primarily use it to seek information and communicate with friends and family, they want to be nurtured (Guo, 2017). Older adults want to be socially included and encouraged when using the internet more often (Niehaves & Plattfaut, 2017). Niehaves and Plattfaut (2017) also found that older adults who frequently utilized the internet had a more extensive social network, promoting connectedness. Older adults who stated that they regularly used the internet also said they seldom felt lonely and isolated. In contrast, those who used the Internet more infrequently reported feeling socially isolated (Peek et al., 2016). According to R. Hill et al. (2015), similar outcomes have been reported in older adults in assisted and independent living communities: increased internet use is linked to decreased loneliness and increased social interaction. Utilizing the internet and digital technology as a tool for communication may afford older adults a means of compensating for any likely changes in lifestyle or physiology associated with aging and cultivate a sense of empowerment (R. Hill et al., 2015).

My study used TAM to support the study's question and construct questions to collect data from web developers that will gather strategies for HCI website developers.

### **Transition and Summary**

Section 1 elucidates the strategies in website development for human-computer interaction for adults over 65 years and the (TAM) in adopting and utilizing technology. The literature review considers relevant literature from 2010 to the present to address the challenges older adults face and their behaviors in accepting and using today's technology and ways to yield favorable acceptance.

Section 2 described the methodology used to gather and analyze data in response to my study's research question. I reiterated the purpose statement and outlined the researcher's role in the study's data collection process. The study's method and design describe the connection to the data collection and analysis process. The section concludes by describing the reliability and validity of the data collection and analysis process.

## Section 2: The Project

This section outlines the research design, method, participant selection, and ethical considerations used for this study. The data collection and data analysis processes for the study are also described.

### **Purpose Statement**

In this qualitative multiple case study, I explored HCI website developers' strategies to build interfaces to meet accessibility requirements for older adults over 65. The targeted population was HCI website developers and designers with knowledge and experience in creating websites with accessibility options for older adults over 65. The study was conducted with participants from website development companies located in the New York City metropolitan area of the United States. The results of this study may provide strategies for HCI web developers to build accessible websites directed toward older adults over 65. The implications for positive social change include the potential for older adults over 65 to have full access to technology that may change their daily lives. The findings may help HCI website developers create accessible websites that allow older adults over 65 to use the internet with fewer challenges to connect with services. Better connection to services via the internet will make communicating with loved ones and the use of services, such as health care and productivity programs, easier.

### **Role of the Researcher**

As the researcher, I was the data collection instrument of this study. A researcher can explore individuals or organizations directly through multifaceted interventions, relationships, communities, or applications (Yin, 2013). My main goal was to gather



quality data to answer the research question. Yin (2014) asserted that to implement a qualitative case study, the researcher must collect information from numerous sources, such as documentation, observation, archived data, and current records.

I was the sole researcher of this qualitative case study. My role in the data collection process of this qualitative multiple case study was to work as the primary data collection instrument, which allowed me to organize and interpret the data. My role in this study was to select participants, conduct interviews, and collect later analyzed data. I gathered information from web designers who design technologies for older adults by conducting interviews, and I also eliminated bias when explaining the information I was collecting. A researcher should take the necessary steps to alleviate bias during the research process because it can skew the information the researcher collects for analysis (Fusch & Ness, 2015). Shelton and Uz (2015) emphasized that when researchers are the principal data collection instrument, they may find it challenging to control their biases during the interviewing process of the participants. As an accomplished network specialist for over ten years working with Cisco Systems routers, switches, and training entry to high-level local area network and wide area network professionals in designing and supporting networks, I studied industry trends to advise program managers of new technology. Through this study, I identified the challenges older adults face as they try to utilize technology, which has become the trend of the 21st century. Past experiences did not affect my impartiality during the interview process. The interview protocol in Appendix A outlines how the interviews were conducted and describes the step-by-step approach taken to the interviews, which guarded against bias.

I did not ask questions that may have influenced the participant's responses during the interview, alleviating any biases. After the participant interviews, I corroborated my interpretation of the participant's responses using member checking to ensure the information presented was accurate and factual. I followed *the Belmont Report's* guiding principles and ethical guidelines, whose principal purpose is protecting participants and subjects in research studies or clinical trials through privacy, consent, anonymity, and protecting information from human participants (U.S. Department of Health and Human Services, 1979).

### **Participants**

Researchers who conduct qualitative research seek participants to provide detailed descriptions of the phenomenon (Draper, 2015). In this case study, the participants were recruited from six website development organizations in the New York City metropolitan area. To obtain participants, I reached out to the Greater New York Chamber of Commerce and the Associated Builders and Contractors of Lower NY State to get contacts of web development organizations. I identified a gatekeeper who provided me with the names and emails of potential participants. I sent a consent form to potential participants, asking for their consent to be part of the study. The inclusion criteria were developed to address the research question: What strategies do HCI website developers use to build HCI interfaces to meet accessibility requirements for adults over 65? The criteria for participation included the following: (a) individuals who are/were full-time web developers, (b) individuals who have been web developers for a minimum of 5 years, (c) individuals who worked creating HCI web interface for older adults over 65,

(d) individuals who worked or lived in the metropolitan area of New York, and (e) individuals with whom I did not have a recurring working relationship. I designed these criteria to maximize the benefits of the research while minimizing risk to participants.

Before communicating with potential participants in a study, researchers must get Institutional Review Board (IRB) approval to ensure proper protections are in place for human participants, including the use of an informed consent process for potential participants (Faden et al., 2013; Lantos & Spertus, 2014; Ryan et al., 2014). Before communicating with the participants, I obtained IRB approval (IRB# 09-17-21-0659069) from Walden University's Center for Research Quality. After receiving approval for the study, I used organizational contacts to request participants to join the study. Shah and Anandane (2013) noted that the researcher is a member of the participant's community (e.g., establishing a basis for empathy with the participant) and is part of establishing rapport, as is providing personal attention to the participant. I established rapport with participants by learning about the culture of the case organization, adapting my attire and behavior to their standards, and working with each participant when selecting a site for interviews to ensure that their privacy and comfort needs were met.

### **Research Method and Design**

Researchers conduct research using three methods: qualitative, quantitative, and mixed methods (Yin, 2014). Depending on the chosen method, researchers use an associated design to form a mechanism to collect data to answer the research question and form the research conclusions (Yin, 2014).

## **Method**

I chose a qualitative approach for this study because I explored the experiences of HCI developers to gather strategies to help other HCI developers who seek to develop accessible websites for older adults over 65. Qualitative studies are conducted to explore and understand the experiences of individuals or groups associated with a social or human problem that involves emerging questions and procedures (Khaldi, 2017). A quantitative approach is used when collecting numerical information (Neuman, 2014). Researchers who conduct quantitative studies form hypotheses on the relationships between variables and use statistical comparisons to formulate a scientific outcome (Cameron et al., 2015). I did not use a quantitative approach in this study because numerical information was not collected and used, and I did not seek to form hypotheses on the relationship between variables. A mixed-method approach combines quantitative and qualitative methods (Kamalodeen & Jameson-Charles, 2016). This approach allows researchers to take advantage of the statistical analysis of a very large sample size and simultaneously combine it with a qualitative approach to reaching participants (Stockman, 2015). In the current study, I did not use the quantitative method and sought only to use the qualitative approach, so a mixed method was unsuitable for the study's goals.

## **Research Design**

Qualitative studies can be carried out using four interactive and noninteractive designs: narrative, case study, ethnography, and phenomenology (Kruth, 2015). I employed an exploratory multiple-case study design in this study. A case study is often

used to allow the researcher to investigate a phenomenon with a bounded context from multiple perspectives to gain in-depth details about that phenomenon (Taylor & Thomas-Gregory, 2015). In the current study, I investigated the strategies used to create accessible websites used by older adults over 65. A narrative inquiry is used to understand the experience of an individual's life and express such findings in the form of storytelling or biographical details (Bell, 2011). I did not employ a narrative inquiry design because the study's goals did not include seeking to understand an individual's life in the form of an autobiography or biography or seeking to find out how that individual's life experience could change or form a theory. An ethnography design is primarily used for describing and interpreting the shared patterns of a group's culture and draws from anthropology and sociology (Khan, 2014). I did not use an ethnographic design because the study's goal was not to study culture group patterns. Kruth (2015) described a phenomenological design as focusing on understanding the principle of a lived phenomenon and drawing from the disciplines of philosophy, psychology, and education. I did not use a phenomenological design because of its focus on the participants' lived experience of a phenomenon; instead, I developed a detailed analysis of one or more cases based on a phenomenon. A multiple case study design was most appropriate for the aims of the current study.

### **Population and Sampling**

The population for this qualitative multiple case study consisted of web developers from three web development organizations within the New York City metropolitan area. The population consisted of HCI developers of websites with

knowledge and experience (at least five years' worth) in developing HCI websites for adults over 65. In this study, I used purposive sampling. Guetterman (2015) defined purposeful sampling as based on cases rich in information used for an in-depth study. Guetterman explained that information-rich cases yield insightful understanding from which one can learn a great deal, including the central importance of the purpose of any inquiry. Guetterman also noted that purposeful sampling is focused on qualitative research and explained purposeful sampling as the primary qualitative approach to case selection. In this study, I employed a homogenous sampling method, which is a type of purposeful sampling method that focuses on candidates who share similar traits or specific characteristics. Etikan and Bala (2017) explained that homogenous sampling participants would be identical in terms of age, culture, jobs, or life experiences. This sampling method focuses on this precise similarity and how it relates to the research topic. Boddy (2016) indicated that sample size in qualitative research depends on the type of study (e.g., in a case study where the participants are in a homogenous setting (i.e., small sample size), data saturation can be reached). The purposeful, homogenous sampling method benefited the current study because the sample size was six participants, two from each web development organization. In this case study, I gathered strategies from HCI web developers on website creation for older adults over 65, making the sample frame HCI website developers.

Data saturation can be achieved when researchers gather data until new information emerges from the sources (Gentles et al., 2015). The sample size for the current study was six different developers from three different software development

organizations. I selected developers from different organizations because developers from any given organization follow standard web development formats. Selecting one or more participants from any individual organization would allow me to gather information until no new information is achieved. I continued to interview participants until no new information emerged in the interviews.

The location of interviews is significant to the interview process and may influence the interview outcomes (Gagnon et al., 2015). The interview location should be safe, private, convenient, and comfortable for the participant (Rimando et al., 2015). I worked with participants to identify a proper meeting setting by sending out an email invitation to them.

### **Ethical Research**

Respect for persons, beneficence, and justice are three ethical considerations in *the Belmont Report* (Ryan et al., 2014). The respect of persons is concerned with allowing participants to control the parameters specified in the informed consent form, and beneficence is concerned with a balance between the benefits and risks of the research (Ryan et al., 2014). I explained the study to the participants in the informed consent form and discussed benefits and justice. I addressed respect for persons through the informed consent process and included information about the participants' ability to opt out of the study at any time without consequences. I also maintained respect for persons by minimizing the potential for coercion because I did not have a subordinate relationship with the potential participants. I minimized the possibility of coercion by

excluding potential participants I may have had a working relationship with by addressing this via the inclusion criteria process.

I obtained IRB approval from Walden University before I began recruiting potential participants for the study. I reached out to the Greater New York Chamber of Commerce and the Associated Builders and Contractors of Lower New York State to get the contact information of organizations that are web development organizations. I then contacted the organizations to get access to participants. Once I got their email addresses, I sent an informed consent form and a copy of the letter of cooperation to the potential participants who met the defined inclusion criteria of the study. This email communication was based on the use of an email template. The email template included my contact information and my availability for any questions if they arose. The consent form also included details of participant criteria, consent, withdrawal, incentives for participation, data retention and protection policies, and individual identity protection. Participants had the ability to withdraw at any time and for any reason without consequences. Potential participants could contact me by email or mobile phone to inform me of their decision. The consent form included a statement detailing that there would be no compensation or other incentive for participation aside from any benefits they may realize.

I will retain all data obtained for this study in a locked safe where it will only be accessible to me, either in print or digital form based on the nature of the data, for five years from the date of final research approval. Participants' identities were anonymized and written as Participant A, Participant B, and Participant F to protect the participants'



confidentiality. Any recorded identifying information of the participants on all transcribed data will be preferred to using these pseudonyms to protect the participants' identities. This information was encrypted and password-protected when stored.

## **Data Collection**

### **Instruments**

I was the main researcher in this study as the data collection instrument for conducting the interviews. According to Yin (2014), when using a qualitative case study design, six sources are used for evidence of discovery: interviews, participant observations, direct observations, archival records, physical artifacts, and documentation. As the primary instrument, I collected data by conducting interviews. According to Yin, when performing qualitative research, the researcher will be the main instrument utilizing active listening while performing direct interviews. Peredaryenko and Krauss (2013) noted that the primary instrument's role is to be unbiased while conducting research and interviews. A face-to-face interview allows the interviewer to visualize body language responding to the interview questions (Irvine et al., 2013). When I conducted the interviews, I paid attention to the participants for any body language or responses that may lead to follow-up questions. Irvine et al. (2013) also found that the lack of face-to-face contact affects the rapport between the interviewer and the interviewee, which may also influence the interviewee's understanding of the questions being asked, and there may be a need to ask for additional clarification. I used open-ended questions in semi-structured interviews following an interview protocol (Appendix A) to collect data for this study.

Face-to-face electronic interviews were my instrument to collect data for my study. The face-to-face interview was done using Zoom software, allowing the interview to be online via webcam. According to Nielsen (1994) and Yin (2014), the use of face-to-face, in-depth interviews will allow participants to answer interview questions that have already been created while at the same time freely discussing additional related information. The purpose of using interviews as an instrument was to gather strategies web developers have in place to create accessible websites for adults over 65. I put the interview protocol (see Appendix A) in place when conducting the interviews to keep the participants' confidentiality and increase validity during the data collection process. The interview questions and interview protocol ensured the ethical guidelines set forth regarding interviewing participants ensured consistency, validity, and trustworthiness of all participants. The interview questions of my study were created to collect data to explore the research question of the study. Castillo-Montoya (2016) stated that interview questions should be created based on the research question and the type of research conducted.

To increase the reliability and validity of the data obtained from participants, I used member checking to revisit the interview results with the participants. Richards (2003) noted that member checking could be used as a technique for validation by verifying the data that was gathered from participants for accuracy based on prior information obtained (p. 287). Member checking allowed me to conduct follow-up interviews to review my interpretation of the original interview. Follow-ups were done by email. In the follow-up email, I shared my interpretation of their interview with the

participants. I asked participants to correct any miscommunications. Loh (2013) noted that member checking is effective for establishing trustworthiness due to the information obtained from the participants, who are the subject matter experts; it allows for validation of the information received. One advantage of using member checking is understanding the issue from the participant's perspective, which will add value to the study. Having many interviews to conduct may lead to more complex coordination of follow-up interviews, which can be time-consuming and serve as a disadvantage of member checking (Loh, 2013).

Vaismoradi et al. (2013) stated that the methodological evaluation of documents electronically and in print is document analysis. I will use organizational documents and policies as my second instrument for methodological triangulation. Vaismoradi et al. suggested that having organizational documents would validate, provide more insight, or confirm interview responses from the participants. With the semi-structured interview responses I collected, I used these responses and corroborated them with the three documents collected from the web developers of the organizations. This corroboration enhanced the reliability and validity of my study.

### **Data Collection Technique**

Semistructured interviews were the primary method of collecting data for the study. I used organizational documents and policies as my second source of data collection. I used an interview protocol (Appendix A) to gather data from the research participants. The interview protocol contained instructions that are expected to take up to two hours to complete. The one-hour time allotted gave the participant enough time to

respond to the questions. The instructions in the interview protocol were developed to include open-ended questions and prompts to remember, such as a prompt to watch for nonverbal cues and probe for clarity.

Petty et al. (2012) noted that when starting a qualitative interview process, the interviewer must explain the process and purpose of the study to the participants. After the approval from IRB and the organizations to be interviewed, I emailed out invitations to the list approved by the gatekeepers. After the participants accepted my invitation, I scheduled face-to-face interviews with these participants. Morse (2015) noted that contacting participants before a face-to-face interview will ensure availability and rapport with the participants.

I read the consent document to the participants to ensure that the document was understood and an explanation of the data collection process was clear. After the participants signed the consent form, I explained that the interview would be audio-recorded, and I also took notes along the way. Member checking was used to provide the authenticity of the data. J. Barnes (2015) explained that having multiple forms of data increases the stability of the research, and data triangulation may be obtained. My second source of data was asking the participants for any documentation used in aiding them in creating accessible websites for adults over 65. This documentation collection is noted in the interview protocol (Appendix A).

I used three organizational documents as my secondary method of data collection. I asked permission from the organization's IT director to collect documents about strategies developers use to build HCI websites accessible by adults over 65. From the interview

protocol (Appendix A), I collected the documents before the start of the semi-structured interview. I used these organizational documents to triangulate the data with the data from the semi-structured interviews. It was stated by Anderson and Perrin (2017) that researchers using organizational policies as a data collection technique are better able to recognize, record, and relay organizational practices with a better environmental and contextual background. I used organizational documentation to triangulate strategies on HCI websites accessible by adults over 65 from multiple sources.

### **Data Organization Techniques**

Mahaliyanaarachchi (2017) stated that having a research journal allows for information to be accessible and to keep track of data and emerging understandings such as research logs and cataloging systems. Audio data is stored on Google Drive and encrypted for security. The organization's documents I collected before the interview were stored in a locked cabinet. Any paper and journals will be kept in a locked cabinet in my home for five years and destroyed one year after completing the study.

### **Data Analysis Technique**

Mangioni and McKerchar (2013) stated that gathering data, organizing it, disassembling the data, reassembling the information, and determining the data's relevancy fall in the data analysis category. In this qualitative multiple case study, I gathered two forms of data sources from the participants. The first form of data was documenting the participants' strategies to create accessible websites for adults over 65. The second form of data was a face-to-face interview using the interview protocol (Appendix B). The face-to-face interview of the participants was audiotaped. Yin (2014)

explained that conducting face-to-face, in-depth interviews allowed participants to answer interview questions that have already been created and, at the same time, freely discuss additional information that is related. Widodo (2014) noted that member checking would allow the participants to reflect on their words and express additional meanings. Using member checking, I corrected any participant data I interpreted incorrectly. Widodo also noted that one disadvantage to member-checking interviews is the rescheduling of seeing participants for a second time. The more participants you have, the harder it is to reschedule. Before starting the data collection process, I obtained my letter of cooperation from the three corporations used in my multiple case studies and IRB approval. Once permission was granted, I worked with the web developers from the three organizations to start setting up interviews.

Yin (2014) found that coding aims to identify themes related to information obtained from the participants. Walby (2015) also identified coding to identify concepts or themes across interviews. Walby acknowledged a five-step qualitative analysis process: compiling, disassembling, reassembling, interpreting, and concluding. I included this five-step process once I collected data from the participants and started the analysis process. The compiling process entailed reviewing completed interviews, the organizational documents from the participants, the audio recordings, and the notes taken during the interview. The disassembling process entailed analyzing the audio and the notes taken manually. The data was reassembled and reanalyzed to identify themes. I used the NVivo software for interpretation and identifying themes. The NVivo software was used to decipher, analyze, and code the recorded interviews. It allowed me to search

the data using queries and various searching methods to validate the interview transcripts. NVivo was used to assist with identifying themes. Walby noted that identifying theme recordings will help determine if additional data needs to be collected regarding the study.

Using multiple data sources in a study is called triangulation, which adds credibility to inductive approaches in case study research (Cronin, 2014; De Massis & Kotlar, 2014; Houghton et al., 2013; Wahyuni, 2012). Fusch and Ness (2015), Houghton et al. (2013), and Wilson (2014) noted that there are four primary types of triangulations in qualitative research: data, investigator, theory, and methodological. When more than one researcher participates in a study, investigator triangulation is applied; when multiple theoretical strategies are employed, theory triangulation is applied; when researchers gather multiple sources of data from more than one person or time applies, you achieve data triangulation; and when the use of multiple methods to analyze and correlate data collected from multiple sources, methodological triangulation is achieved (Fusch & Ness, 2015; Wahyuni, 2012; Wilson, 2014).

I used data and methodological triangulation in my study. Investigator triangulation was not applicable as I was the only investigator in my research. Theory triangulation was not used, as I used one conceptual framework in my research. I used methodological triangulation by collecting interviews and organizational document data to analyze all gathered data from the collection process to organize the data.

## **Reliability and Validity**

In conducting a doctoral study, the reliability of the data collected should be maintained during the doctoral study process. Babbie and Neustadtl (1989) noted that reliability affirms that the researcher's approach is true and replicable. Svensson and Doumas (2013) indicated that one method of ensuring reliability in a research study is to ensure that the research method stays consistent throughout the study. Turgut (2014) explained that when research information is documented correctly, it ensures the repeatability of the data that is being collected. Yin (2014) noted that when utilizing case study research, reliability can be shown if another researcher using the same procedures obtains similar results. Lub (2015) stated that validity questions if the study's conclusions prove feasible in the eyes of the participants. Trochim (2006) noted that reliability and validity in qualitative research could be broken down into four criteria: credibility, transferability, dependability, and confirmability. Trustworthiness is a necessary part of qualitative research, and one of the methods used to achieve trustworthiness is developing a chain of evidence (Sinkovics & Alfoldi, 2012). I outlined in the sections to follow the methods I used for trustworthiness. I maintained reliability when collecting data from the participants by following the interview protocol. I ensured the consistency of the processes used during the interviews by using the interview questions approved.

### **Dependability**

Dependability refers to the stability of the data. Data must remain stable during the analyzing phase, that is, the extent to which data change over time and the alterations made in the researchers' decisions (Bengtsson, 2016). The focus would be to keep track



of coding decisions, and the researcher must use memos to track changes in the development because re-coding and relabeling often happen during the process (Bengtsson, 2016). The data obtained should be similar for the participant and detailed. Daigneault and Jacob (2013) stated that for the study to be dependable, researchers must stay neutral when evaluating data, including sampling and analysis. Richards (2003) stated that member checking incorporated in a study increases dependability. Member checking allows participants to verify the information obtained, which validates the credibility of the data. I addressed dependability by including a reflexive journal of my study data. I maintained dependability by establishing the chain of evidence recording when and from whom the data will be collected in my study database. I used member checking by sending an email summary of the interview to participants, where I shared my interpretation of our first interview and asked them to check the correctness.

### **Creditability**

Wren and Barbera (2013) and Yin (2013) stated that credibility could be established by incorporating methods of prolonged engagement, debriefing sessions, member checking, iterative data collection, and triangulation of data sources. I incorporated member checking within the data collection process and data triangulation when analyzing the data. I arrived at data saturation by gathering data from semistructured interviews and organizational documents, using member checking to ensure accurate and complete interpretation of the data, employing expert sampling, and using methodological triangulation.

### **Transferability**

J. Barnes (2015) noted that confirming transferability asks the researcher to consider if they have provided enough information for other researchers to transfer findings. Houghton et al. (2013) stated that a researcher should increase transferability by thoroughly presenting research findings and using a thick description of the background, data collection methods, and data sources. I presented my research findings using a thick description of the background, data collection methods, and data sources.

### **Confirmability**

When researchers establish and manage a chain of evidence that coordinates data collection and data analysis to the conclusion, it demonstrates that the research is credible. Based on the viewpoint of the participants, validation methods, and the sources utilized to collect the data or chains of evidence, reflexive journals meet the need for confirmability (Houghton et al., 2013; Petty et al., 2012; Wahyuni, 2012; Yilmaz, 2013). I maintained logs and stored them with the remainder of my study data. I logged when and from whom I collected data, creating a chain of evidence.

### **Transition and Summary**

This section presents the methodology I used in this study. This qualitative multiple case study methodology was my chosen method and design for my purpose. The data collection process outlined allowed me to choose participants ethically while maintaining reliable, nonbiased data. I provided details of the project, indicating that this qualitative multiple-case study aimed to explore the strategies that HCI website developers use to build interfaces to meet accessibility requirements for older adults over 65. I gathered all data collection, acting as the primary data collection instrument. I

followed all guidelines regarding the ethical treatment of participants outlined in the Belmont Report, including informed consent. I collected data from interviews and organizational documents. I used data and methodological triangulation across multiple data sources to ensure saturation and completeness. I addressed validity and reliability through member checking using reflexive journals. Section 3 provides the results of the study in a more detailed form.

### Section 3: Application to Professional Practice and Implications for Change

In this section, I present the findings of this qualitative multiple case study exploring the strategies web developers used to build accessible websites and applications for older adults over 65. I collected data through virtual, face-to-face interviews using Zoom. Organization documents reviewed were web links provided by the participants during the interviews. The findings were triangulated from reports, themes, and subthemes extracted and derived from the collected data. In this section, I also discuss the applications to professional practice, implications for social change, recommendations for action, and recommendations for further study.

#### **Overview of Study**

The purpose of this qualitative multiple-case study was to explore the strategies that HCI website developers use to build interfaces to meet accessibility requirements for older adults over 65. I collected data via semistructured, virtual, face-to-face interviews with four HCI web developers from two web development organizations within the New York City metropolitan area. The web developers had 15 to 30 years of experience in the HCI web development industry. I also reviewed documents available on public website links provided by the participants and took field notes during the interviews. Three major themes were identified through data analysis: (a) ease of readability and accessibility, (b) ease of navigation and simplicity, and (c) importance of feedback. I describe the three major themes in the following subsection.

### **Presentation of the Findings**

The three emerging themes demonstrated strategies website developers use to build accessible websites for adults over 65 effectively. Tables 2–5 display the frequencies of participant responses attributed to the three themes. The tables also include the documents provided by the organizations and how the themes relate to the documents.

The participants were web developers with a wide range of experience in building and designing interfaces that interact with users of all ages. Six web developers agreed to participate in the study, three from each case organization; however, only four participants completed the interviews, two from each case. The fifth and sixth participants did not follow through on the interview. The four interviewed participants collectively had over ten years of building and designing websites. The participants consisted of three men and one woman. No biases were found because the research questions were not gender-based.

Data saturation was achieved after interviewing Participant 3 because no new themes were identified or emerged when Participant 4 was interviewed. I used methodological triangulation to analyze the two major data sources, the semistructured interviews and organizational documents. I also used my field notes that consisted of critical issues raised during the interviews. The field notes were beneficial in the data triangulation process to provide a convergence of evidence to support the credibility of the findings. Validating the findings diminished the effect of potential bias because I gathered data through semistructured interviews and organizational documents. Table 1 provides the organizational document list.

**Table 1***Organizational Document List*

Document	Name	Abbreviation
1	Web Content Accessibility Guidelines	WCAG
2	Authoring Tool Accessibility Guidelines	ATAG
3	User Agent Accessibility Guidelines	UAAG

**Theme 1: Ease of Readability and Accessibility**

The first theme from the data analysis was the importance of ease of readability and accessibility to allow older adults over 65 to read and access websites easily. Table 2 shows the five subthemes that evolved from my analysis in the NVivo software to produce Theme 1 and includes the count (i.e., number) of participants who implemented these strategies to the ease of readability and accessibility. The number of times the participant references each subtheme is also included in Table 2. The number of supporting documents associated with each subtheme is also included in Table 2.

**Table 2***Subthemes for Theme 1: Ease of Readability and Accessibility*

Subthemes	Participant		Document
	Count	References	Count
Accessibility	4	9	3
Colors and contrast	3	7	2
Images	3	5	2
Text	3	9	3
Language	1	1	2

I conducted the data analysis process using the NVivo software to generate the following subthemes: colors and contrast, images, languages, text, and accessibility. The colors and contrast subtheme supported best practices to make websites more readable to older adults over 65. In contrast, the language and text subthemes supported best practices that make websites clear to older adults over 65. The accessibility subtheme supported best practices that make websites simplistic and easily accessed by older adults over 65. All participants indicated that applying best practices when creating and designing websites that included components to provide older adults over 65 with ease of use when accessing and reading content would help lower the challenges that older adults over 65 have in website usage.

Participants A, B, and D supported the colors and contrast subthemes. Participants A, B, and D reported that website development must follow guidelines in terms of colors and contrast. Participant D reported strategies such as balancing colors and allowing

users to zoom onto the screen and the ability to change the setting of the mouse.

Participants A and B indicated a strategy of controlling colors and contrast by having a color legend to help vision-challenged users remember what an object is used for when going from page to page. They also discussed providing a way to change the contrast on the fly so that the darker mode can be easily changed. Participant B stated,

Make sure that there are two colors that would not blend into one another because if they did on a certain screen or certain device that had a different color profile – the general idea is to keep whatever is as legible as possible, as readable as possible, as clear as possible and to have multiple ways to identify each type of action.

Participants A, B, and D pointed out the importance of having color and contrast strategies in making websites more accessible and readable for older adults over 65.

Participant responses also supported the image subtheme. Participants A, B, and D talked about strategies in image representation on a webpage, including having a way to instantly decrease or increase the size of an image on any device screen. Participant A stated that images should have a text association for users with blurred vision who use a reader to read text on the screen. Participant B talked about having images represent text for those users who have arthritis and cannot use the whole keyboard. Participant B stated,

As people get older, they are more likely to have arthritis or a delayed reaction time as people over age 65 make it so “well, you got to click this tiny checkbox.”



That's very difficult for somebody, so don't make it a tiny checkbox; make it a big "I Accept" button.

I included language as a subtheme that supports the theme's accessibility and readability because the keyboard or onscreen keypad is specific to the language used. Participant B talked about language strategy to make the language clear and provide a way to get help easily. Image representation was identified as a key concern for older adults.

Participants' responses supported the text subtheme as well. Participants A, B, and C provided strategies on text representation on a webpage, including a microphone that allows users to speak and provide text, allowing users to change the font size by zooming and providing a button to make text larger and brighter. All participants reported the accessibility subtheme included strategies to help adults over 65 access web content better. The data collected and analyzed for Theme 1 answered the research question.

I received links during the interviews to three documents that supported the participant responses to the theme of accessibility and readability of websites by adults over 65. The documents are the Web Content Accessibility Guidelines (WCAG), Authoring Tool Accessibility Guidelines (ATAG), and User Agent Accessibility Guidelines (UAAG). All three documents are part of the World Wide Web Consortium (W3C) web accessibility initiatives guide that provides strategies, standards, and resources to make web content accessible to people. The accessibility subtheme was mentioned in all three of the documents, the color and contrast subtheme was mentioned in two of the documents, the images subtheme was mentioned in two of the documents,

the text subtheme was mentioned in all three documents, and the language subtheme was mentioned in two of the documents.

The WCAG document provided techniques on color and contrast that supported what Participants A, B, and D stated regarding strategies to help older people over 65 read and access websites. The WCAG document provided evidence that older people's color perception changes, and they lose their sensitivity to contrast. The WCAG listed guidelines that supported techniques for the use of color that require that color is not used as the only visual means of conveying information, indicating an action, prompting a response, or distinguishing a visual element. The WCAG document also listed guidelines that supported that the minimum contrast that older people should use requires a contrast ratio of at least 4.5:1 for the visual presentation of text and images, and enhanced contrast requires a higher contrast ratio of at least 7:1 for the visual presentation of text and images. This document fully supports the theme of accessibility and readability of websites by older adults over 65.

The WCAG document also provided techniques in accessibility that supported the responses of Participants A, B, C, and D. The WCAG stated that many older adults need particularly clear and identifiable links due to declining vision and cognition. Some strategies in the document that aligned with the participants were providing a link to text that describes the purpose of the link, limiting the number of links per page, and making links visually distinct. Participant B reported that older adults have a decline in hand motion. The WCAG supported evidence that some older people cannot use a mouse well or at all and instead use a keyboard. The WCAG listed guidelines that recommended

strategies, such as all functionality of the content being operable through a keyboard interface, a mechanism being available to bypass blocks of content that are repeated, and providing a highly visible highlighting mechanism for links or controls when they receive keyboard focus. The WCAG also provided evidence that some older people use text-to-speech (i.e., speech synthesis) software, which is becoming increasingly available in browsers and operating systems. This aligned with Participant D's strategy of reading text. The WCAG indicated that many older adults struggle to understand complex sentences, unusual words, and technical jargon, supporting Participant B's language strategy. The WCAG's guidelines supported strategies for language, such as using the clearest and simplest language appropriate for the content and making the text easier to read by replacing long and unfamiliar words with shorter, more common ones. The WCAG fully supports Theme 1.

The second and third documents, the ATAG and UAAG, listed guidelines that supported strategies that synced with the accessibility subtheme, the image subtheme, the color and contrast subtheme, the text subtheme, and the language subtheme. The strategies included providing controls on the webpage that allow users to incrementally change the size of all text on the page up to 200%; providing a button on the page to increase line and paragraph spaces; using a contrast ratio of 3:1 with surrounding text; providing additional visual cues on focus for links or controls where color alone is used to identify them; providing a version of a movie with audio descriptions; using label elements to associate text labels with form controls; providing access to a human customer service representative who can bypass CAPTCHA, using an author-supplied,

highly visible focus indicator; highlighting a link or control when the mouse hovers over it; and placing the interactive elements in an order that follows sequences and relationships within the content. The ATAG and UAAG both support Theme 1.

The findings of Swenor et al. (2020), Peek et al. (2016), and Gitlow (2014) supported Theme 1. Swenor et al. noted a consistent relationship between vision loss and cognitive function among older adults. Age-related macular degeneration, diabetic retinopathy, glaucoma, and cataracts are associated with worse cognitive test scores and cognitive impairment. They also noted that it is well established that vision impairment affects psychosocial functioning, substantially affecting quality of life, disability, and overall health. Peek et al. established that older adults prefer to age in their familiar environment, and policies support them in remaining in their homes and communities. Peek et al. stated that “Technology can play a role in staying independent, active and healthy” (para. 1). The authors provided evidence that older adults’ perceptions and use of technology are entrenched in their social, personal, and physical background therefore, Peek et al. recommended aging in place using the technology, contextual and psychological factors needed. Gitlow provided evidence that supported older adults’ challenges when using the computer, mentioning that the barriers included lack of knowledge, negative attitudes, and age-related changes, such as vision and hearing loss and fine motor difficulties.

Theme 1 is also supported by the STAM conceptual framework, which extends the TAM and focuses on tying ease of use with accessibility and readability. According to Wang et al. (2018), the STAM is one of the few technology acceptance models

concentrating on older adults and general gerontechnology. Factors impelling older adults' technology acceptance are individual attributes such as gender, age, education, gerontechnology anxiety, and self-efficacy. The strategies of Theme 1 are supported by the STAM, which shows that older adults can adapt to technology with the developer's use of guidelines that work to help older adults read and access web content. Wang et al. recommended that psychological, physical, and social characteristics associated with aging may affect how an older adult interacts with technology and devices. The W3C guidelines also help with the interaction of older adults with technology.

### **Theme 2: Ease of Navigation and Simplicity**

The second theme that came from the data analysis was ease of navigation and simplicity to allow adults over 65 to easily navigate a more user-friendly website. Table 3 shows the five subthemes that evolved from the data analysis for theme two and includes the count (number) of participants who implemented these strategies to ease navigation and simplicity. The number of times the participant references each subtheme is also included in Table 3. The number of supporting documents associated with each subtheme is also included in Table 3.

**Table 3**

*Subtheme for Theme 2: Ease of Navigation and Simplicity*

Subthemes	Participant		Document
	Count	References	Count
Navigation	4	8	2

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Simplicity and consistency	2	4	2
Device compatibility	2	4	2
Front-end interaction	3	7	2

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The ease of navigation and simplicity theme is divided into five subthemes: navigation, simplicity and consistency, device compatibility, and front-end interaction. The navigation and device compatibility subthemes supported best practices used to navigate websites easily from different devices by adults over 65. The simplicity and consistency subthemes supported best practices used to easily browse websites consistent with font, text, image, and sound by adults over 65. The front-end and interaction subthemes supported best practices that allow older adults to easily interact with websites from any device, including handheld devices. All participants indicated that by applying best practices when creating/designing websites that included components to provide adults over 65 the ease of use when navigating websites, making content simple and consistent to access, making websites easy to use and interact with across multiple devices and make interaction consistent, would help lower the challenges that adults over 65 have in website usage.

Participant responses supported the navigation subtheme. Participant B reported that having a site map would help older adults navigate websites. Participant B stated, “So having clean site maps, clean hierarchies, and a consistent set of indicators in multiple ways to tell somebody you’re in this section of the site versus that section of the site, and you can find your way back.” Participant B also reported that having a way to go

back to the top of the screen from the bottom of the screen would help ease navigation.

Participant B stated, “Older adults can feel lost in a site, especially as you get into sites with these tremendous hierarchies and trees and going down ten different levels.”

Participants A, C, and D reported that cutting down on the amount of content on each page would make it easier for scrolling for older adults. They also talked about other adults using the keyboard to navigate, which makes it easier on their hands. Participant B spoke about the stress of clicking and touching screens. Participant B reported that older adults, due to their lack of motor skills, are challenged by the number of clicks per page, so cutting down on the number of clicks would contribute to the ease of navigation.

Participants C and D also talked about clicks per page. They reported that spacing out elements on a page, especially on mobile devices, would help in navigating the page by older adults.

Participants responses that supported the simplicity subtheme. Participants A, B, C, and D reported best practices for having simplicity and consistency in working with webpages for adults over 65. Participant A talked about the challenges older adults have because of age. Motor skills and disabilities add to these challenges. Participant A reported designing webpages to be simple and consistently easy for older adults. It is simple for them to read a page or just have the page be the same simple layout on every page. Participant B talked about making webpages simpler by not having so many technical terms that older adults are not used to or heard of on webpages that are more frequent by older adults. Participant C talked about keeping applications across devices consistent and not making drastic changes, which adds to challenges for older adults.

Participant D summed up simplicity and consistency by listing several best practices, namely,

A blind user is choosing a tool where a lot of the browser now has tools built in to allow them to navigate web pages; the simpler it is, the easier it works; keep it simple. If things get complicated, it hurts everybody, especially the end user.

Participant D noted that if you have a webpage that has a hundred different things on it and is not well organized, it is poor design and that the first thing a user will do is to break this page down to 20 items, organize them as best they can, and then it progressed to another page that has another 20 items. All participants had examples of the value of simplicity in developing websites for older adults.

Participants' responses supported the device compatibility subtheme. Participants B and C reported best practices that supported the subtheme. Participant B said that when designing for multiple devices, maintain consistency across devices and not limit these devices. An example of such a limitation would be to provide the same menu across all devices to maintain continuity. If you use the word "menu" on one device, then use the same word on similar devices, thus eliminating any confusion. Participant B said, "On touch-based elements, it's even more important to think about an over-65 audience whose fingers might not be as precise as someone under 65. They make shake their fingers, so putting space between things is important." Participant C reported that the consistency between the iPhone and iPad devices, where everything looks the same, helps adults over 65 because they can adapt between devices. Participants B and C used several examples to support the device compatibility subtheme.



Participant responses supported the front-end integration subtheme. Participants A, B, and D reported best practices that provided examples to support the subtheme. Participant A suggested, “Targeted animation might be one to start with. Targeted animations. Using no more than one to guide the eye or guides the individual who will notice the movement and gravitate towards that.” Participant A indicated that sound might also be a plus when rolling over some objects to include sought-after sounds. But, when each project is unique, there is no one cookie-cutter approach; it depends on the disability. Participant B reported that sites can be designed to work for audiences over 65 and under 65, with differences based on the level of challenges. Participant D summed up theme two by saying that having websites that are easy to interact with across devices reduces challenges for adults over 65. All participants reported that the Ease of Navigation and Simplicity theme included strategies to help adults over 65 access web content better. The data collected and analyzed for theme two answer the research question, " What strategies do HCI website developers use to build HCI interfaces to meet accessibility requirements for adults over 65?

The three documents, (WCAG), (ATAG), and (UAAG), provided support for the Ease of Navigation and Simplicity theme. The navigation subtheme was mentioned in two documents, the simplicity and consistency subthemes were mentioned in two documents, the device compatibility subtheme was mentioned in two documents, and the front-end interaction subtheme was mentioned in two documents.

The WCAG document provided techniques on navigation that supported the participants’ responses. All 4 participants stated that ease of navigation strategies would

help older people over 65 navigate websites. The WCAG document provided evidence that older people need navigation to be particularly clear due to declining cognitive abilities. The WCAG listed guidelines that supported techniques for navigating; namely, more than one way is available to locate a web page within a set of web pages; information about the user's location within a set of web pages is available; web pages have titles that describe topic or purpose (this is important for search results as the page title is usually displayed first in the listing). The WCAG also mentioned providing a site map that supported Participant B's responses, providing a search function to help users find content, providing descriptive titles for web pages to help understand the results from search-based navigation, providing a breadcrumb trail, indicating the current location within navigation bars, and providing a link to the home page or main page. The WCAG also supported Participants A, C, and D, who agreed that these were best practices. The WCAG listed guidelines that supported techniques for simplicity and consistency. The WCAG provided evidence that it is difficult for some older people to understand the requirements of forms and transactions. The WCAG guidelines for simplicity and consistency included ensuring labels or instructions are provided when content requires user input, context-sensitive help is available, and components with the same functionality within a set of web pages are identified consistently. Some of the other consistency and simplicity guidelines that were provided by WCAG matching participants A, B, C, and D were providing text instructions at the beginning of a form or set of fields that describe the necessary input, providing linear form design and grouping similar items, providing spell checking and suggestions for text input, providing expected

data format and example, and using labels, names, and text alternatives consistently for content that has the same functionality.

The WCAG also provided guidelines for device compatibility that supported data provided by participant C. Guidelines included providing a submit button to initiate a change of context, describing what will happen before a change to a form control that causes a change of context to occur is made, and providing a mechanism to request an update of the content instead of updating automatically. The guidelines provided by the WCAG supported the front-end interaction best practices. Guidelines included were including a reading assistant that allows listening and reading at the same time to help older adults read and understand the content, using specialized mice with custom designs for specific users, ones with additional keys, ones that compensate for trembling, and other dexterity limitations, and many more. The guidelines stated that while ergonomic mice are often available at ordinary computer retailers, specialized mice are usually developed by assistive technology vendors. The findings of the study supported the WCAG guidelines for device compatibility.

The second document, ATAG, listed guidelines that supported strategies for the navigation subtheme, the simplicity and consistency subthemes, the device compatibility subtheme, and the front-end interaction subtheme, all participants mentioned in the interviews. Strategies included laptop users attaching external mice in addition to the pointing device built into the computer; providing additional capability to identify and block animated, blinking, flickering, or otherwise distracting (sometimes hazardous) content; by having specialized web browsers and online services convert text into

symbols and icons that are easier to understand and use by older people with cognitive challenges; and using voice recognition to dictate text or to control the entire computer. For example, voice commands can launch or close applications like the web browser or perform actions such as selecting links or scrolling on a web page. These support the responses from the participants.

Peek et al. (2016), Swenor et al. (2020), and Caldwell et al. (2008) supported Theme 2. Swenor et al. mentioned that age-related macular degeneration may affect the navigation of websites for older adults; diabetic retinopathy, glaucoma, and cataracts may affect how adults over 65 view smaller font, text, and images on websites. They also reported that vision impairment affects navigation functions, substantially affecting the ease with which older adults navigate websites, working with different devices, and front-end interaction. Peek et al. established that older adults use technology more at home as they prefer to age in their familiar environment, and there are policies to support them remaining in their own homes and communities, supporting theme 2. The authors provided evidence that older adults' use of technology is entrenched in their social, personal, and physical background, and being able to navigate websites, using devices to use the Internet, and having interactive front-end devices make for simplicity. Therefore, contextual and psychological factors are needed to support aging in place using technology, for example, easy-to-navigate websites, compatible devices, larger fonts and images for content consistency, and easy front-end interaction (Peek et al., 2016). Caldwell et al. also supported theme 2. The authors provided evidence that older adults are challenged when using devices to access online content when faced with disabilities.

They mentioned guidelines that will make content accessible to a wider range of people with disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity, and combinations. The authors mentioned that following these guidelines will also often make your Web content more usable to users in general of blindness. The above studies supported theme 2 in supporting strategies to improve navigation and simplicity.

This theme is also supported by the STAM framework that focuses on tying ease of use with navigation and simplicity. Some challenges that affect older adults with technology acceptance include navigating easily accessing content via web browsing and the simplicity of handling some technological devices. The strategies from this study are supported by STAM, which showed that older adults can adapt to technology with the developer's use of guidelines that improve their ability to navigate and simplify access to web content. Wang et al. (2018) recommended using guidelines during the development phase that consider the psychological, physical, and social characteristics associated with aging that may affect how an older adult interacts with technology and devices.

### **Theme 3: Importance of Feedback**

The third theme from the data analysis was the importance of feedback to allow web developers and web designers to draw from the experiences of older adults using webpages to improve their experiences and make it less challenging for them to use. Table 4 shows the four subthemes that evolved from the NVivo software that produced theme three and includes the count (number) of participants who implemented these strategies for the importance of feedback. The number of times the participant references

each subtheme is also included in Table 4 as the number of supporting documents associated with each subtheme.

**Table 4**

*Subthemes for Theme 3: Importance of Feedback*

Subthemes	Participant		Document
	Count	References	Count
Feedback	4	5	2
Implementation	2	2	2
Testing	4	11	3
Standards	3	9	2

The subthemes of the importance of feedback are feedback, implementation, testing, and standards. The implementation subtheme supported best practices to help build websites that function easily for adults over 65. The testing and standards subtheme supported best practices to have websites look and feel comfortable with technology changes to suit adults over 65. All participants indicated that by applying best practices when creating/designing websites to include feedback from adults over 65, changes to technology standards, implementation, and testing results would help lower the challenges adults over 65 have in website usage.

All participant responses supported the implementation and feedback subthemes. Participant C reported that,

I would have to go where they are. They would like more human interaction. I would think that would be preferable. Like somebody in the family explaining to

them, or they can't go anywhere. Typically, they are at home, so there is no way of saying, hey, you do training. If you say do training, you must take them somewhere to explain some things.

Participant D said that if there is a new app, for example, a banking app, invite the seniors to try it out and make changes according to their comfort level. Participant B said that,

Then you also look for, not just before you launch the site, but because sites are constantly being updated, you know there's no more we built the site, we forget about the site. It's you who build the site; you live with the site, and that's just day one of the site. Day two is when you rebuild it and add something. So, you see how people interact with the site and what complaints they have, and you listen quickly to 'I couldn't see this' or 'I couldn't figure that out.'

Participant D said that using the W3C guidelines for feedback and implementation of websites would not take long to make the sites cater to adults over 65. It would be an investment using the W3C tools.

Participants' responses supported the testing and standards subthemes. All participants reported best practices that supported testing and standards. Participant A said,

Well, feedback usually comes from either testing. We get feedback from testing when we create an application. We want to test it, so our feedback comes from real-world testing with our customers, and then we observe if it meets the requirements stated in the document.

Participant B said that using focus groups of older adults to test websites helps to give instant feedback. He also mentioned that they used testing while the website was being used by an older adult, using a recorder for testing that records their usage and movements. The recordings help to pinpoint exactly what they need to fix. Participant B went on to say that task-based testing of websites helps identify misunderstandings of the usage of the site. Participant C stated that,

So, I would say it should simulate – so, the use case would be people with physical frailties, right? Vision is not there; you can't hear well. So, just the physical inabilities, right? That is one thing considered, so it must be something that takes care of that issue.

Participant C also reported that older adults must be included in technology growth when making website changes. He said they can make an impact on the changes to be made. Participant D stated

Bring it back to the user to test it, and then usually when they see it, they say oh no, these are not the things we wanted, and then they go back to prototyping until they are happy with the idea and then create it.

Participant D summed up testing, saying always to have somebody test. Participant A stated that standards are essential to follow up on. Participant A also stated that technology changes and standards are updated. Participant A went on to say that accessibility standards follow the guidelines of the W3C. Participant B said, "a series of standards, but those evolve and have continued to evolve as the tools and technologies have changed over time and gotten more sophisticated, but in general, the bedrock principles are all the same."



Participant B also said that a best practice is to use the standards by the W3C. Participant D said that the W3C has more awareness of the latest accessibility standards, and their tools are user-friendly to follow. Participant D summed up theme three by supporting following the guidelines of the W3C to help provide testing, implementation, and standards for the evolving technology in creating websites for adults over 65. All participants reported that the accessibility code included strategies to help adults over 65 access web content. The data collected and analyzed for theme 3 answers the research question: " What strategies do HCI website developers use to build HCI interfaces to meet accessibility requirements for adults over 65?"

Two documents mentioned the feedback subtheme, the standards subtheme, and the implementation subtheme. The testing subtheme was mentioned in three of the documents.

The WCAG document provided techniques on the feedback subtheme that supported what participants A, B, C, and D stated on strategies to help older people over 65 handle working with errors on web pages. The guidelines included were that pages with legal commitments or financial transactions have reversible submissions and can be checked and corrected; that users can check and correct any information they submit if an input error is automatically detected, the item that is in error is identified and the error is described to the user; accepting input data in a variety of formats; making error messages easy to understand and distinguishable from other text in the web page; and providing a text description that contains information about the number of input errors, suggestions for corrections to each item, and instructions on how to proceed. The WCAG document

provided techniques on the implementation subtheme that backed what participants B and D stated on strategies that would help older people over 65 easily use web pages.

Techniques included giving users advanced warning when opening a new window, opening new windows only when best from an accessibility perspective, opening new windows by providing normal hyperlinks without the target attribute, and presenting repeated components in the same relative order each time they appear. The WCAG document provided techniques on the testing and standard subthemes that backed what participants A, B, C, and D reported to help older users over 65 make easy use of web pages. Techniques included requiring that markup is used correctly according to specification, validating web pages, and fully conforming to specifications. When an authenticated session expires, the user can continue the activity without losing data after reauthenticating. These assistive strategies support the responses from the participants.

The second and third documents, (ATAG), and (UAAG) listed guidelines that supported strategies that synced with the feedback subtheme, the implementation subtheme, the testing subtheme, and the standard subtheme that all participants mentioned in the interviews. Strategies included using assistive technologies, which are software or equipment that people with disabilities use to improve interaction with the web, such as screen readers that read aloud web pages for people who cannot read text, screen magnifiers for people with some types of low vision, and voice recognition software and selection switches for people who cannot use a keyboard or mouse. These assistive strategies support the responses from the participants.

Barnard et al. (2013), Peek et al. (2016), and Swenor et al. (2020) supported theme 3. Swenor et al. noted that using feedback from older adults allowed them to conclude that a relationship between vision loss and cognitive function among older adults has been reported. They went on to note that observing a group of older adults using technology would help identify the challenges they have using it and gather feedback to form a solution. Peek et al. also supported theme 3. “Technology can play a role in staying independent, active and healthy” (para.1). The authors provided evidence from observing older adults and pointed out that their perceptions and use of technology are entrenched in their social, personal, and physical background. According to Peek et al., feedback from older adults is needed to provide solutions to support aging in place using technology. Barnard et al. also supported theme 3. The authors provided evidence of older adults' difficulty in using digital devices. They mentioned that without feedback and training, these older adults cannot use digital devices to access content on the Internet. They mentioned if web developers have a channel to tap into the challenges that older adults face through continued feedback from older adults when accessing content via the Internet. They would build with the older adult in mind.

This theme supports the STAM conceptual framework that focuses on tying ease of use with the importance of feedback. The senior technology acceptance model (STAM) is an extension of TAM. According to Wang et al. (2018), STAM is one of the few technology acceptance models concentrating on older adults and general gerontechnology. Using feedback from older adults may give more knowledge on age, gerontechnology, anxiety, and gender, which are some factors propelling technology

acceptance. Wang et al. recommended that seeing exactly how these factors affect seniors, for example, using group forums with older adults giving feedback, would contribute to formulating ways to help develop better technology to be accepted. The W3C guidelines on using feedback to help with older adults' interaction with technology.

### **Applications to Professional Practice**

This study intended to explore HCI website developers' strategies to build interfaces to meet accessibility requirements for older adults over 65 working in the New York City Metropolitan area, New York. The findings of this study, in conjunction with an analysis of its conceptual framework and a review of academic literature, added to the current body of knowledge of web development and design strategies to make websites more accessible to adults over 65.

The findings are pertinent to web developers, web designers, and older adults to enhance the design and development of websites that cater to the ease of accessibility for older adults. Participants of this study indicated that their participation would contribute to enhancing the limitations to existing website access by adults over 65.

Individuals use the Internet to shop, pay bills, go to school, do taxes, communicate with health professionals, access medical and health information, and sign up for retirement benefits (Gitlow, 2014). However, according to the findings of this research, older seniors are often not skilled in accessing these resources. By providing successful web development strategies, organizations may adopt these successful strategies and enhance website accessibility for older adults.

Strategies like ease of accessibility and readability, ease of navigation, and the importance of feedback can improve information technology practice by providing web developers strategies to improve website content access for adults over 65. These best practices may lead to older adults' technical ability to contact friends and family to maintain more doable relationships with these devices. Older seniors can reach a broader social support network using these communication activities (Gonzalez et al., 2015).

### **Implications for Social Change**

Older adults are using technology to support their daily lives. These older adults come across challenges when accessing web content. Technology advancements, including emailing, video conferencing, locating places, chatting, and exchanging images, are standard but are not always easily accessible by older seniors (Mitzner et al., 2016). Researchers have found that, although older seniors are not skilled in using all the typical applications, they are proficient in using their computers to access the Internet and for email (Mitzner et al., 2016).

The results of this study identified strategies HCI web developers use to design and build websites that accommodate older adults over 65. The findings of this study may contribute to social change by improving the daily life of older adults. Strategies that may help older adults use website technology effectively to enhance their lives through communication and access to information; older adults can easily navigate websites using any device. The study's contributions may open the world to older adults in terms of more online activities, benefit their families so they can use distance communication, and benefit health providers to have more contact with older seniors. Web developers and

web designers will benefit from the results of this study. The use of the guidelines suggested in this study will give them feedback on how to build more accessible websites for older adults, which will improve their quality of life.

### **Recommendations for Action**

The study findings uncovered three key web development strategies that web developers use to build accessible websites for adults over 65. I recommend that web developers and designers use these strategies to build websites that address accessibility and readability for adults over 65. These strategies reduce the challenges they face in using the internet. The second recommendation is for web developers to follow guidelines to create websites with better navigation and simplicity. The third recommendation to web developers and designers is to listen to feedback from older adults about their experiences and build accordingly. These significant findings supported current literature on web development strategies to help build accessible websites.

More challenges are expected as technology evolves and more online services are available to older adults. With these changes, web developers need web development strategies to keep up. Web developers must consider how to update guidelines to continue to build more accessible websites for older adults.

Disseminating this study's findings will occur after receiving CAO approval for this study. A short-page summary of the research results will be sent to all four research participants. The study results will also be shared in academic communities through the ProQuest database globally to students and scholars. I plan to present the findings in IT professional seminars and conferences and publicize my study in peer-reviewed journals.

### **Recommendations for Further Study**

The findings of this study revealed strategies used by web designers and developers to provide accessibility and ease of use for adults over 65. All participants were geographically located in the New York metropolitan area. This was a limitation identified early in the research. Repeating the study in different geographical regions of the United States based on older adults' Internet usage, using a different conceptual framework and methodology, will benefit organizations, web developers, web designers, and older adults.

This study added to the existing web development strategies literature, but additional research is warranted due to the small sample size used by qualified web designers and developers. Future work may consider exploring website development strategies with larger sample sizes or larger organizations. Finally, this study has contributed to the literature on web development strategies for older adults but may also benefit web users with disabilities.

Finally, this study also recommended some important issues that must be addressed in the IT marketplace. Based on the literature review and the collected data of this study, recommendations for future research topics were highlighted:

- further research to explore more strategies for web access on smaller devices.
- further research to explore the barriers preventing web developers from having more access to guidelines to create websites for older adults.

- research should explore the key components to understanding the gathering of feedback from older adults' usage of devices that give them access to content on the web.

### **Reflections**

The research process improved and elevated my understanding of doctoral-level research. I was challenged by the level of detail and alignment this research study entailed and was overwhelmed during the findings and analysis phase. Sometimes, I felt like giving up; I did not want to write anymore. I became interested in my study topic after volunteering at my county library, working with older adults and their challenges with the computer. Seeing how they struggle, I sought to understand from the web developer's perspective in creating accessible websites. As an IT professional with over 20 years of experience, I had some bias before conducting this study about website development strategies. I minimized my bias by allowing the participants to express themselves without offering my opinions. My knowledge of the topic did not bias the study because I used open-ended questions throughout the semistructured interview process, resulting in rich, comprehensive data based on the participants' experiences.

I was unaware of the qualitative study's involvement until I started collecting and analyzing data. Recruiting participants for my study was challenging, and two of the six participants who agreed to participate were unavailable via Zoom to be interviewed. However, I was able to reach data saturation with the 4 participants. Transcribing the audio-recorded interviews took over 5 hours due to playback issues. Analyzing the transcript was also overwhelming due to learning NVivo to formulate codes. The findings



from this study identified well-defined strategies that web developers and web designers can use to create accessible websites for older adults.

This study has prepared me and has given me enough understanding to conduct a qualitative research study that may be used in my future career. My academic writing skills have improved since I enrolled at Walden University, and I intend to continue building on them. I am now equipped with the academic skillset to confidently write research articles on web development strategies for accessible websites for older adults.

### **Summary and Study Conclusions**

The study identified strategies used by HCI website developers to create accessible websites for older seniors to be able to provide these strategies to HCI developers lacking this skill set to create accessible sites for older adults. By enhancing their skill set, they may be able to create websites that better serve the needs of older adults, easily using websites for acquiring information and using emails more efficiently from any device. Their enhanced efficiency can broaden their environments through social networking.

The problem statement addressed the issues older seniors face in accessing information using computer technology. Learning about HCI web development strategies for creating an accessible design for older adults may help inform other HCI developers where they lack in creating accessible HCI websites for older adults. A literature review included current studies that evidence older seniors' issues when using and accessing websites. The methodology used to collect and analyze data that identified and

understand the skills needed for HCI web developers to build better HCI websites for older adults was a multi-case qualitative.

This study identified strategies HCI web developers use to design and build websites that accommodate older adults over 65 with internet interactivities. The study results detailed strategies to improve websites that are easier for older adults. This study may contribute to social change by providing benefits to older adults. Easier communication using various devices would contribute to more online activities. More access to services devoted to older people, for example, social security and medication websites, would be a major benefit.

## References

- Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, 84(5), 888–918.  
<https://doi.org/10.1037/0033-2909.84.5.888>
- Anderson, M., & Perrin, A. (2017, May 17). *Tech adoption climbs among older adults*.  
<http://www.pewinternet.org/2017/05/17/technology-use-among-seniors/>
- Aottiwerch, N., & Kokaew, U. (2017, July). Design computer-assisted learning in an online augmented reality environment based on Shneiderman's eight golden rules. In *2017 14th International Joint Conference on Computer Science and Software Engineering* (pp. 1-5). IEEE. <https://doi.org/10.1109/jcsse.2017.8025926>
- Arfaa, J., & Wang, Y. K. (2014, June). A usability study on elder adults utilizing social networking sites. In *International Conference of Design, User Experience, and Usability* (pp. 50-61). Springer. [https://doi.org/10.1007/978-3-319-07626-3\\_5](https://doi.org/10.1007/978-3-319-07626-3_5)
- Babbie, E., & Neustadtl, A. (1989). The practice of social research. *Teaching Sociology*, 17(4), 499. <https://doi.org/10.2307/1318433>
- Barbara, B. N., Fonseca, J. R. S., Amaro, F., & Pasqualotti, A. (2018). Social capital and internet use in an age-comparative perspective focused on later life. *PLoS One*, 13(2) <https://doi.org/10.1371/journal.pone.0192119>
- Barhoumi, C. (2016). User acceptance of the e-information service as an information resource. *New Library World*, 117(9), 626-643. <https://doi.org/10.1108/nlw-06-2016-0045>

- Barnard, Y., Bradley, M. D., Hodgson, F., & Lloyd, A. D. (2013). Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour, and usability. *Computers in Human Behavior*, 29(4), 1715-1724.  
<https://doi.org/10.1016/j.chb.2013.02.006>
- Barnes, J. (2015). Qualitative research from start to finish (2nd ed.). *Neuropsychological Rehabilitation*, 1–3. <https://doi.org/10.1080/09602011.2015.1126911>
- Barnes, S. J., & Vidgen, R. T. (2006). Data triangulation and web quality metrics: A case study in e-government. *Information & Management*, 43(6), 767-777.  
<https://doi.org/10.1080/09602011.2015.1126911>
- Bashir, R. N., Qadri, S., Saleem, R. M., Naeem, M., & Ghafoor, Y. (2014). Human-computer interaction (HCI) in ubiquitous computing. *International Journal of Innovation and Applied Studies*, 9(2), 534-540.
- Bell, E. E. (2011). A narrative inquiry: A black male looking to teach. *The Qualitative Report*, 22(4), 1137-1150.
- Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, 2, 8-14. <https://doi.org/10.1016/j.npls.2016.01.001>
- Berkowsky, R. W., Sharit, J., & Czaja, S. J. (2017). Factors predicting decisions about technology adoption among older adults. *Innovation in Aging*, 1(3), igy002.  
<https://doi.org/10.1093/geroni/igy002>
- Bhattacharjee, A. (2001). Understanding information systems continuance: an expectation-confirmation model. *MIS Quarterly*, 351-370.

- Bhattacharjee, A., & Premkumar, G. (2004). Understanding changes in belief and attitude toward information technology usage: A theoretical model and longitudinal test. *MIS Quarterly*, 229-254. <http://eli.johogo.com/Class/p4.pdf>
- Boddy, C. R. (2016). Sample size for qualitative research. *Qualitative Market Research: An International Journal*. <https://doi.org/10.1108/QMR-06-2016-0053>
- Bowles, K. H., Dykes, P., & Demiris, G. (2015). The use of health information technology to improve care and outcomes for older adults. *Research in Gerontological Nursing*, 8(1), 5-10. <https://doi.org/10.3928/19404921-20121222-01>
- Burnett, J. S., Mitzner, T. L., Charness, N., & Rogers, W. A. (2011, September). Understanding predictors of computer communication technology use by older adults. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 55(1), 172-176. SAGE Publications. <https://doi.org/10.1177/1071181311551036>
- Busse, C., Kach, A., & Wagner, S. (2016). Boundary conditions: What they are, how to explore them, why we need them, and when to consider them. *Organizational Research Methods*, 1-36. <https://doi.org/10.1177/1094428116641191>
- Caldwell, B., Cooper, M., Reid, L. G., Vanderheiden, G., Chisholm, W., Slatin, J., & White, J. (2008). Web content accessibility guidelines (WCAG) 2.0. *WWW Consortium (W3C)*, 290, 1-34.

- Cameron, R., Sankaran, S., & Scales, J. (2015). Mixed methods used in project management research. *Project Management Journal*, 46(2), 90-104.  
<https://doi.org/10.1002/pmj.21484>
- Carolyn, H. S., Jones, L. M., Moss, K. O., Variath, M., & Wright, K. D. (2018). African American older adults' perceived use of technology for hypertension self-management. *Research in Gerontological Nursing*, 11(5), 249-256.  
<https://doi.org/10.3928/19404921-20180809-02>
- Castillo-Montoya, M. (2016). Preparing for interview research: The interview protocol refinement framework. *The Qualitative Report*, 21, 811-830.
- Chiu, C., & Liu, C. (2017). Understanding older adult's technology adoption and withdrawal for elderly care and education: Mixed method analysis from a national survey. *J Med Internet Res*, 19(11), e374. <https://doi.org/10.2196/jmir.7401>
- Cronin, C. (2014). Using case study research as a rigorous form of inquiry. *Nurse Researcher*, 21(5), 19–27. <https://doi.org/10.7748/nr.21.5.19.e1240>
- Currie, M., Philip, L. J., & Roberts, A. (2015). Attitudes towards the use and acceptance of eHealth technologies: a case study of older adults living with chronic pain and implications for rural healthcare. *BMC Health Services Research*, 15(1).  
<https://doi.org/10.1186/s12913-015-0825-0>
- Czaja, S. J. (2015). Can technology empower older adults to manage their health? *Generations*, 39(1), 46-51.  
<https://www.ingentaconnect.com/content/asag/gen/2015/00000039/00000001/art00010>

- Daigneault, P.-M., & Jacob, S. (2013). Unexpected but most welcome: Mixed methods for the validation and revision of the participatory evaluation measurement instrument. *Journal of Mixed Methods Research*, 8, 6–24.  
<https://doi.org/10.1177/1558689813486190>
- Datta, A., Bhatia, V., Noll, J., & Dixit, S. (2019). Bridging the digital divide: Challenges in opening the digital world to the elderly, poor, and digitally illiterate. *IEEE Consumer Electronics Magazine*, 8(1), 78-81.  
<https://doi.org/10.1109/MCE.2018.2867985>
- Davis, F. (1985). *A technology acceptance model for empirically testing new end-user information systems: theory and results*. [Doctoral dissertation], Sloan School of Management, M.I.T.  
<https://www.researchgate.net>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-339.  
<https://doi.org/10.2307/249008>
- Davis, F. D. (2015). On the relationship between HCI and technology acceptance research. *Human-Computer Interaction and Management Information Systems: Applications*, D. Galletta, ed, 395-401.  
[http://digilib.stmik-banjarbaru.ac.id/data.bc/14.%20Human%20Computer%20Interaction/2006%20H](http://digilib.stmik-banjarbaru.ac.id/data.bc/14.%20Human%20Computer%20Interaction/2006%20Human-)  
uman-

Computer%20Interaction%20and%20Management%20Information%20Systems  
%20Foundations.pdf#page=410

- de Lara, S. M. A., de Mattos Fortes, R. P., Russo, C. M., & Freire, A. P. (2016). A study on the acceptance of website interaction aids by older adults. *Universal Access in the Information Society, 15*(3), 445-460. <https://doi.org/10.1007/s10209-015-0419-y>
- De Massis, A., & Kotlar, J. (2014). The case study method in family business research: Guidelines for qualitative scholarship. *Journal of Family Business Strategy, 5*(1), 15–29. <https://doi.org/10.1016/j.jfbs.2014.01.007>
- Draper, J. (2015). Ethnography: Principles, practice, and potential. *Nursing Standard, 29*(36), 36–41. <https://doi.org/10.7748/ns.29.36.36.e8937>
- Dupuis, K., & Tsotsos, L. E. (2018). Technology for remote health monitoring in an older population: A role for mobile devices. *Multimodal Technologies and Interaction, 2*(3). <https://doi.org/10.3390/mti2030043>
- Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal, 5*(6), 00149. <https://doi.org/10.15406/bbij.2017.05.00149>
- Faden, R. R., Kass, N. E., Goodman, S. N., Pronovost, P., Tunis, S., & Beauchamp, T. L. (2013). An ethics framework for a learning health care system: A departure from traditional research ethics and clinical ethics. *Hastings Center Report, 43*(s1), S16–S27. <https://doi.org/10.1002/hast.134>



- Festinger, L., & Pepitone, A. (1959). *A Theory of Cognitive Dissonance*. *The American Journal of Psychology*, 72(1), 153. <https://doi.org/10.2307/1420234>
- Fusch, P. I., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report*, 20, 1408–1416. <https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=ir00976a&AN=wldu.sm.pubs.1049&site=eds-live&scope=site>
- Gagnon, M., Jacob, J. D., & McCabe, J. (2015). Locating the qualitative interview: Reflecting on space and place in nursing research. *Journal of Research in Nursing*, 20, 203–215. doi:10.1177/1744987114536571
- Gentles, S. J., Charles, C., Ploeg, J., & McKibbin, K. A. (2015). Sampling in qualitative research: Insights from an overview of the methods literature. *The Qualitative Report*, 20, 1772–1789. <http://nsuworks.nova.edu/tqr>
- Geraedts, H. A., Zijlstra, W., Zhang, W., Bulstra, S., & Stevens, M. (2014). Adherence to and effectiveness of an individually tailored home-based exercise program for frail older adults, driven by mobility monitoring: design of a prospective cohort study. 14:570. <https://doi.org/10.1186/1471-2458-14-570>
- Gitlow, L. (2014). Technology use by older adults and barriers to using technology. *Physical & Occupational Therapy In Geriatrics*, 32(3), 271-280. <https://doi.org/10.3109/02703181.2014.946640>
- Gonzalez, A., Maria, P. R., & Viadel, V. (2015). ICT learning by older adults and their attitudes toward computer use. *Current Gerontology and Geriatrics Research*, 2015. <https://doi.org/10.1155/2015/849308>

- Greenwald, P., Stern, M. E., Clark, S., & Sharma, R. (2018). Older adults and technology: In telehealth, they may not be who you think they are. *International Journal of Emergency Medicine (Online)*, 11(1), 1-4.  
<https://doi.org/10.1186/s12245-017-0162-7>
- Guetterman, T. (2015). *Descriptions of sampling practices within five approaches to qualitative research in education and the health sciences*. <https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=edsdoj&AN=edsdoj.4128d874665d485b835ea2534227d5a4&site=eds-live&scope=site>.
- Gulliksen, J. (2017). Institutionalizing human-computer interaction for global health. *Global Health Action*, 10 <https://doi.org/10.1080/16549716.2017.1344003>
- Guo, P. J. (2017, May). Older adults are learning computer programming: motivations, frustrations, and design opportunities. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 7070-7083). ACM.  
<https://doi.org/10.1145/3025453.3025945>
- Haesner, M., Steinert, A., O'Sullivan, J. L., & Steinhagen-Thiessen, E. (2015). Evaluating an accessible web interface for older adults - the impact of mild cognitive impairment (MCI). *Journal of Assistive Technologies*, 9(4), 219-232.  
<https://doi.org/10.1108/jat-11-2014-0032>

- Hill, N. L. (2017). Person-centered technology for older adults. *Journal of Gerontological Nursing, 43*(4), 3-4. <https://doi.org/10.3928/00989134-20170313-01>
- Hill, R., Betts, L. R., & Gardner, S. E. (2015). Older adults' experiences and perceptions of digital technology:(Dis) empowerment, wellbeing, and inclusion. *Computers in Human Behavior, 48*, 415-423. <https://doi.org/10.1016/j.chb.2015.01.062>
- Hornbæk, K., & Hertzum, M. (2017). Technology acceptance and user experience: A review of the experiential component in HCI. *ACM Transactions on Computer-Human Interaction (TOCHI), 24*(5), 33. <https://doi.org/10.1145/3127358>
- Houghton, C., Casey, D., Shaw, D., & Murphy, K. (2013). Rigour in qualitative case study research. *Nurse Researcher, 20*, 1217. <https://doi.org/10.7748/nr2013.03.20.4.12.e326>
- Irvine, A., Drew, P., & Sainsbury, R. (2013). Am I not answering your questions properly? Clarification, adequacy and responsiveness in semi-structured telephone and face-to-face interviews. *Qualitative Research, 13*, 87-106. <https://doi.org/10.1177/1468794112439086>
- Kamalodeen, V. J., & Jameson-Charles, M. (2016). A mixed methods research approach to exploring teacher participation in an online social networking website. *International Journal of Qualitative Methods, 1-14*. <https://doi.org/10.1177/1609406915624578>

- Kang, S. L. C., Endacott, C. G., Gonzales, G. G., & Bengtson, V. L. (2019). Capitalizing and compensating: Older adults' religious and spiritual uses of technology. *Anthropology and Aging, 40*(1), 14-31. doi:10.5195/aa.2019.194
- Kernisan, L. (2016). Promises and pitfalls: Technology and the future of delivering eldercare. *Generations, 40*(1), 92-98.  
[https://www.researchgate.net/publication/304929624\\_Promises\\_and\\_pitfalls\\_Technology\\_and\\_the\\_future\\_of\\_delivering\\_eldercare/citation/download](https://www.researchgate.net/publication/304929624_Promises_and_pitfalls_Technology_and_the_future_of_delivering_eldercare/citation/download)
- Khalidi, K. (2017). Quantitative, qualitative or mixed Research: Which research paradigm to use? *Journal of Educational and Social Research, 7*(2),  
<https://doi.org/10.5901/jesr.2017.v7n2p15>
- Khan, S. N. (2014). Qualitative research method: Grounded theory. *International Journal of Business and Management, 9*(11), 224. <https://doi.org/10.5539/ijbm.v9n11p224>
- Kisekka, V., Chakraborty, R., Bagchi-Sen, S., & Rao, H. R. (2015). Investigating factors influencing web-browsing safety efficacy (WSE) among older adults. *Journal of Information Privacy & Security, 11*(3), 158-173.  
<https://doi.org/10.1080/15536548.2015.1073534>
- Kruth, J. G. (2015). Five qualitative research approaches and their applications in parapsychology 1. *The Journal of Parapsychology, 79*(2), 219. -233.  
<https://search.proquest.com/docview/1776152718?pq-origsite=gscholar&fromopenview=true>

- Lantos, J. D., & Spertus, J. A. (2014). The concept of risk in comparative-effectiveness research. *New England Journal of Medicine*, *371*, 2129–2130.  
<https://doi.org/10.1056/NEJMhle1413301>
- Lawton, M. P., & Nahemow, L. (1973). Ecology and the aging process. In C. Eisdorfer & M. P. Lawton (Eds.), *The psychology of adult development and aging* (pp. 619–674). Washington, DC: American Psychological Association.  
<https://doi.org/10.1037/10044-020>
- Lee, C., & Coughlin, J. F. (2015). Perspective: Older adults' adoption of technology: An integrated approach to identifying determinants and barriers. *Journal of Product Innovation Management*, *32*(5), 747–759. <https://doi.org/10.1111/jpim.12176>
- Leitner, M., Strauss, C., & Stummer, C. (2016). Web accessibility implementation in private sector organizations: Motivations and business impact. *Universal Access in the Information Society*, *15*(2), 249-260. <https://doi.org/10.1007/s10209-014-0380-1>
- LeRouge, C., Van Slyke, C., Seale, D., & Wright, K. (2014). Baby boomers' adoption of consumer health technologies: a survey on readiness and barriers. *Journal of Medical Internet Research*, *16*(9), e200. doi:10.2196/jmir.3049
- Li, Q., & Luximon, Y. (2019). Older adults' use of mobile device: usability challenges while navigating various interfaces. *Behaviour & Information Technology*, 1–25.  
<https://doi.org/10.1080/0144929x.2019.1622786>
- Loh, J. (2013). Inquiry into Issues of Trustworthiness and Quality in Narrative Studies: A Perspective. *The Qualitative Report*, *18*(33), 1-15.

[https://www.researchgate.net/profile/Jason\\_Loh/publication/260312062\\_Inquiry\\_i  
nto\\_Issues\\_of\\_Trustworthiness\\_and\\_Quality\\_in\\_Narrative\\_Studies\\_A\\_Perspectiv  
e/links/0c960530c1a8e125b0000000.pdf](https://www.researchgate.net/profile/Jason_Loh/publication/260312062_Inquiry_into_Issues_of_Trustworthiness_and_Quality_in_Narrative_Studies_A_Perspective/links/0c960530c1a8e125b0000000.pdf)

Lub, V. (2015). Validity in qualitative evaluation: Linking purposes, paradigms, and perspectives. *International Journal of Qualitative Methods*, 14, 1–8.

<https://doi.org/10.1177/1609406915621406>

Luna-García, H., Mendoza-González, R., & Álvarez-Rodríguez, F. (2015). Design patterns to enhance accessibility and use of social applications for older Adults/Patronos de diseño para mejorar la accesibilidad y uso de aplicaciones sociales para adultos mayores. *Comunicar*, 23(45), 85-93. doi:10.3916/c45-2015-09

Luszczynska, A., & Schwarzer, R. (2005). Social cognitive theory. *Predicting health behaviour*, 2, 127-169. [https://new.iums.ac.ir/files/hshe-  
soh/files/predicting\\_Health\\_beh\\_avior\(1\).pdf#page=144](https://new.iums.ac.ir/files/hshe-soh/files/predicting_Health_beh_avior(1).pdf#page=144)

Magsamen-Conrad, K., Upadhyaya, S., Joa, C. Y., & Dowd, J. (2015). Bridging the divide: Using UTAUT to predict multigenerational tablet adoption practices. *Computer Human Behavior*. <https://www.ncbi.nlm.nih.gov/pubmed/25937699>

Mahaliyanaarachchi, R. (2017). Knowledge dissemination and exchange of the newly created knowledge. *Journal of Agricultural Sciences–Sri Lanka*, 12(2).

<https://doi.org/10.4038/jas.v12i2.8224>

Mangioni, V., & McKerchar, M. (2013). Strengthening the validity and reliability of the Focus group as a method in tax research. *eJournal of Tax Research*, 11, 176-190.

<https://heinonline.org/HOL/LandingPage?handle=hein.journals/ejotaxrs11&div=16&id=&page=>

Marchibroda, J. M. (2015). New technologies hold great promise for allowing older adults to age in place. *Generations*, 39(1), 52-55.

<https://www.ingentaconnect.com/content/asag/gen/2015/00000039/00000001/art00011>

Marzano, G., Lubkina, V., & Stafeckis, G. (2016). Some reflections on designing effective social telerehabilitation services for older adults. *International Journal of Telerehabilitation*, 8(2), 3-8. doi:10.5195/ijt.2016.6195

McMurtrey, M. E., Zeltmann, S. M., Downey, J. P., & McGaughey, R. E. (2011). Seniors and technology: Results from a field study. *Journal of Computer Information Systems*, 51(4), 22-30.

<https://www.tandfonline.com/doi/abs/10.1080/08874417.2011.11645498>

McSweeney-Feld, M. (2017). Assistive technology and older adults in disasters: Implications for emergency management. *Disaster Medicine and Public Health Preparedness*, 11(1), 135-139. <https://doi.org/10.1017/dmp.2016.160>

Mitzner, T. L., Rogers, W. A., Fisk, A. D., Boot, W. R., Charness, N., Czaja, S. J., & Sharit, J. (2016). Predicting older adults' perceptions about a computer system designed for seniors. *Universal Access in the Information Society*, 15(2), 271-280. <https://doi.org/10.1007/s10209-014-0383-y>

- Morse, J. M. (2015). Critical analysis of strategies for determining rigor in qualitative 128 inquiry. *Qualitative Health Research*, 25, 1212–1222.  
<https://doi.org/10.1177/1049732315588501>
- Moult, A., Burroughs, H., Kingstone, T., & Chew-Graham, C. (2018). How older adults self-manage distress – does the internet have a role? A qualitative study. *BMC Family Practice*, 19 <https://doi.org/10.1186/s12875-018-0874-7>
- Mubarak, F., & Nycyk, M. (2017). Teaching older people internet skills to minimize grey digital divides. *Journal of Information, Communication & Ethics in Society*, 15(2), 165-178. <https://doi.org/10.1108/jices-06-2016-0022>
- Myhre, J. W., Mehl, M. R., & Glisky, E. L. (2017). Cognitive benefits of online social networking for healthy older adults. *The Journals of Gerontology: Series B*, 72(5), 752-760. <https://doi.org/10.1093/geronb/gbw025>
- National Institutes of Health. (2016). *World's older population grows dramatically*. <https://www.nih.gov/news-events/news-releases/worlds-older-population-grows-dramatically>
- Neuman, D. (2014). Qualitative research in educational communications and technology: a brief introduction to principles and procedures. *Journal of Computing in Higher Education*, 26(1), 69-86. <https://doi.org/10.1007/s12528-014-9078-x>
- Niehaves, B., & Plattfaut, R. (2017). Internet adoption by older adults: Employing IS technology acceptance theories for understanding the age-related digital divide. 23(6). 708-726. *European Journal of Information Systems*.  
<https://doi.org/10.1057/ejis.2013.19>



- Nielsen, J. (1994). Usability inspection methods. In *Conference companion on Human factors in computing systems* (pp. 413-414). ACM.  
<https://doi.org/10.1145/259963.260531>
- Peek, S. T., Luijkx, K. G., Rijnaard, M. D., Nieboer, M. E., van der Voort, C. S., Aarts, S., ... & Wouters, E. J. (2016). Older adults' reasons for using technology while aging in place. *Gerontology*, *62*(2), 226-237. <https://doi.org/10.1159/000430949>
- Peredaryenko, M. S., & Krauss, S. E. (2013). Calibrating the human instrument: Understanding the interviewing experience of novice qualitative researchers. *Qualitative Report*, *18*, 1-17. <https://nsuworks.nova.edu/tqr/vol18/iss43/1/>
- Petty, N. J., Thomson, O. P., & Stew, G. (2012). Ready for a paradigm shift? part 2: Introducing qualitative research methodologies and methods. *Manual Therapy*, *17*, 378–384. <https://doi.org/10.1016/j.math.2012.03.004>
- Pikna, J., Fellnerova, N., & Kozubik, M. (2018). *Information Technology and Seniors. Prague: Central Bohemia University*. <https://doi.org/10.12955/cbup.v6.1236>
- Piraino, E., Byrne, K., Heckman, G. A., & Stolee, P. (2017). Caring in the information age: Personal online networks to improve caregiver support. *Canadian Geriatrics Journal*, *20*(2), 85-93. <https://doi.org/10.5770/cgj.20.271>
- Pittarello, F., & Pellegrini, T. (2017). HCI and education: A blended design experience. *Multimedia Tools and Applications*, *76*(4), 4895-4923.  
<https://doi.org/10.1007/s11042-016-3782-7>

Purkait, S., Raj, H., & Das, S. (2019). Human-computer interactions: The way forward.

*IUP Journal of Information Technology*, 15(1), 49-61.

<https://search.proquest.com/docview/2214891234?accountid=6724>

Renaud, K., & Van Biljon, J. (2008). Predicting technology acceptance and adoption by

older adults: a qualitative study. In *Proceedings of the 2008 annual research*

*conference of the South African Institute of Computer Scientists and Information*

*Technologists on IT research in developing countries: riding the wave of*

*technology* (pp. 210-219). ACM. <https://doi.org/10.1145/1456659.1456684>

Richards, K. (2003). *Qualitative inquiry in TESOL*. Springer.

<https://doi.org/10.1057/9780230505056>

Rimando, M., Brace, A. M., Namageyo-Funa, A., Parr, T. L., Sealy, D.-A., Davis, T.,

...Christiana, R. (2015). Data collection challenges and recommendations for early career researchers. *The Qualitative Report*, 20, 2025–2036.

<http://nsuworks.nova.edu/tqr/>

Roy, S. (2017). Scrutinizing the factors influencing customer adoption of app-based cab

services: An application of the technology acceptance model. *IUP Journal of*

*Marketing Management*, 16(4), 54-69. <https://web.b.ebscohost.com/>

Ryan, K. J., Brady, J., Cooke, R. E., Height, D. I., Jonsen, A. R., King, P., ... Turtle, R.

(2014). The Belmont report: Ethical principles and guidelines for the protection of human subjects of research. *The Journal of the American College of Dentists*,

81(3), 4–13. <http://acd.org/publications.htm>

- Schmidt, L., Wahl, H. W., & Plischke, H. (2014). Older adults' performance in technology-based tasks: Cognitive ability and beyond. *Journal of gerontological nursing*, 40(4):18-24. <https://doi.org/10.3928/00989134-20140218-02>
- Selwyn, N. (2004). The information aged: A qualitative study of older adults' use of information and communications technology. *Journal of Aging studies*, 18(4), 369-384.  
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.471.8718&rep=rep1&type=pdf>
- Shah, H., & Anandane, S. S. (2013). Security issues on cloud computing. *International Journal of Computer Science and Information Security*, 11, 25–34.  
<https://arxiv.org/ftp/arxiv/papers/1308/1308.5996.pdf>
- Shelton, B. E., & Uz, C. (2015). Immersive technology and older adults: A mini-review. *National Institutes of Health*. 61(2)175-85. <https://doi.org/10.1159/000365754>
- Sheng, X., & Zolfagharian, M. (2014). Consumer participation in online product recommendation services: Augmenting the technology acceptance model. *The Journal of Services Marketing*, 28(6), 460-470. <https://doi.org/10.1108/jsm-04-2013-0098>
- Shneiderman, B. (2004). Designing for fun: How can we design user interfaces to be more fun? *interactions*, 11(5), 48-50. <https://doi.org/10.1145/1015530.1015552>
- Shore, L., Power, V., de Eyto, A., & Leonard, W. O. (2018). Technology acceptance and user-centered design of assistive exoskeletons for older adults: A commentary. *Robotics*, 7(1), 3. <https://doi.org/10.3390/robotics7010003>

- Sinkovics, R. R., & Alfoldi, E. A. (2012). Progressive focusing and trustworthiness in qualitative research. *Management International Review*, 52, 817–845.  
<https://doi.org/10.1007/s11575-012-0140-5>
- Stockman, C. (2015). Achieving a doctoral through mixed methods research. *The Electronic Journal of Business Research Methods*, 13(2), 74-84.  
<https://issuu.com/academic-conferences.org/docs/ejbrm-volume13-issue2-article401>
- Suresh, V., Prabhakar, K., Santhanalakshmi, K., & Maran, K. (2016). Applying technology acceptance (TAM) model to determine the factors of acceptance in out-patient information system in private hospital sectors in Chennai City. *Journal of Pharmaceutical Sciences and Research*, 8(12), 1373-1377.  
[https://www.researchgate.net/publication/320696249\\_Applying\\_technology\\_acceptance\\_TAM\\_model\\_to\\_determine\\_the\\_factors\\_of\\_acceptance\\_in\\_out-patient\\_information\\_system\\_in\\_private\\_hospital\\_sectors\\_in\\_Chennai\\_city](https://www.researchgate.net/publication/320696249_Applying_technology_acceptance_TAM_model_to_determine_the_factors_of_acceptance_in_out-patient_information_system_in_private_hospital_sectors_in_Chennai_city)
- Svensson, L., & Doumas, K. (2013). Contextual and analytic: Qualities of research methods exemplified in research on teaching. *Qualitative Inquiry*, 19, 441-450.  
<https://doi.org/10.1177/1077800413482097>
- Swenor, B. K., Lee, M. J., Varadaraj, V., Whitson, H. E., & Ramulu, P. Y. (2020). Aging with vision loss: A framework for assessing the impact of visual impairment on older adults. *The Gerontologist*, 60(6), 989-995.
- Taylor, R., & Thomas-Gregory, A. (2015). Case study research. *Nursing Standard*, 29(41), 36–40. <https://doi.org/10.7748/ns.29.41.36.e8856>

- Tennant, B., Stellefson, M., Dodd, V., Chaney, B., Chaney, D., Paige, S., & Alber, J. (2015). eHealth literacy and Web 2.0 health information seeking behaviors among baby boomers and older adults. *Journal of Medical Internet Research*, *17*(3), e70. <https://doi.org/10.2196/jmir.3992>
- Trochim, W. M. K. (2006). *Research Methods Knowledge Base*. Web Center for Social Research Methods. <http://www.socialresearchmethods.net/kb/qualval.php>
- Turgut, M. (2014). Development of the spatial ability self-report scale (SASRS): reliability and validity studies. *Qualitative and Quantitative Analysis in Social Science*, *49*, 1997-2014. <https://doi.org/10.1007/s11135-014-0086-8>
- U.S. Department of Health and Human Services. (1979). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research*. <https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/index.html>
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, *15*(3), 398–405. <https://doi.org/10.1111/nhs.12048>
- Van Zaalen, Y., McDonnell, M., Mikołajczyk, B., Buttigieg, S., Requena, M., & Holtkamp, F. (2018). Technology implementation in delivery of healthcare to older people: How can the least voiced in society be heard? *Journal of Enabling Technologies*, *12*(2), 76–90. <https://doi.org/10.1108/jet-10-2017-0041>
- Vaportzis, E., Giatsi Clausen, M., & Gow, A. J. (2017). Older adults perceptions of technology and barriers to interacting with tablet computers: A focus group study. *Frontiers in Psychology*, *8*, 1687. <https://doi.org/10.3389/fpsyg.2017.01687>

- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478. <https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=edsgea&AN=edsgcl.108912880&site=eds-live&scope=site>
- Venkatesh, V., Thong, J. Y. L., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, *17*(5), 328-376. . <https://doi.org/10.17705/1jais.00428>
- Vroman, K. G., Arthanat, S., & Lysack, C. (2015). “Who over 65 is online?” Older adults’ dispositions toward information communication technology. *Computers in Human Behavior*, *43*, 156-166. . <https://doi.org/10.1016/j.chb.2014.10.018>
- Wahyuni, D. (2012). The research design maze: Understanding paradigms, cases, methods and methodologies. *Journal of Applied Management Accounting Research*, *10*(1), 69–80. [https://doi.org/10.1675/1524-4695\(2008\)31](https://doi.org/10.1675/1524-4695(2008)31)
- Walby, K. (2015). Marshall, Catherine, and Gretchen B. Rossman, Designing Qualitative Research. *Canadian Journal of Sociology*, *40*(3), 399-402. <https://doi.org/10.29173/cjs25398>
- Walsh, R. (2015). Wise ways of seeing: Wisdom and perspectives. *Integral Review*, *11*(2), 156-174. [integral-review.org/issues/vol\\_11\\_no\\_2\\_walsh\\_wise\\_ways\\_of\\_seeing.pdf](http://integral-review.org/issues/vol_11_no_2_walsh_wise_ways_of_seeing.pdf)
- Walsh, R., Drasga, R., Lee, J., Leggett, C., Shapnick, H., & Kottorp, A. (2018). Activity engagement and everyday technology use among older adults in an urban area.

*The American Journal of Occupational Therapy*, 72(4), 1-7.

<https://doi.org/10.5014/ajot.2018.031443>

Wang, K. H., Chen, G., & Chen, H.-G. (2018). *Understanding Technology Adoption Behavior by Older Adults. Social Behavior and Personality: An International Journal*, 46(5), 801–814. . <https://doi.org/10.2224/sbp.6483>

Widodo, H. P. (2014). Methodological considerations in interview data transcription. *International Journal of Innovation in English Language Teaching and Research*, 3, 101-107.

Williams, K., Pennathur, P., Bossen, A., & Gloeckner, A. (2016). Adapting telemonitoring technology use for older adults: A pilot study. *Research in Gerontological Nursing*, 9(1), 17-23. . <https://doi.org/10.3928/19404921-20150522-01>.

Williams, M. D., Rana, N. P., & Dwivedi, Y. K. (2015). The unified theory of acceptance and use of technology (UTAUT): A literature review. *Journal of Enterprise Information Management*, 28(3), 443-488. . <https://doi.org/10.1108/jeim-09-2014-0088>

Wilson, V. (2014). Research methods: Triangulation. *Evidence Based Library and Information Practice*, 9(1), 74–75.  
<https://ejournals.library.ualberta.ca/index.php/EBLIP>

Wion, R. K., & Loeb, S. J. (2015). Older adults engaging in online dating: What gerontological nurses should know. *Journal of Gerontological Nursing*, 41(10), 25-35. . <https://doi.org/10.3928/00989134-20150826-67>

- Wren, D., & Barbera, J. (2013). Gathering evidence for validity during the design, development, and qualitative evaluation of thermochemistry concept inventory items. *Journal of Chemical Education*, *90*, 1590–1601. .  
<https://doi.org/10.1021/ed400384g>
- Wu, Y. H., Damnée, S., Kerhervé, H., Ware, C., & Rigaud, A. S. (2015). Bridging the digital divide in older adults: A study from an initiative to inform older adults about new technologies. *Clinical Interventions in Aging*, *10*, 193. <https://doi.org/10.2147/CIA.S72399>
- Yilmaz, K. (2013). Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences. *European Journal of Education*, *48*, 311–325. . <https://doi.org/10.1111/ejed.12014>
- Yin, R. K. (2013). Validity and generalization in future case study evaluations. *Evaluation*, *19*, 321–332. doi:10.1177/1356389013497081
- Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: SAGE Publications. <https://doi.org/10.3138/cjpe.30.1.108>
- Zamani, B., & Shoghlbad, R. (2017). Experience of applying technology acceptance model (TAM) in using ICT. *Journal of Education Research*. *6*(2): 241-255.  
<https://search-ebscohost-com.ezp.waldenulibrary.org/login.aspx?direct=true&db=edo&AN=85445319&site=eds-live&scope=site>.



- Zheng, R., Spears, J., Luptak, M., & Wilby, F. (2015). Understanding Older Adults' Perceptions of Internet Use: An Exploratory Factor Analysis. *Educational Gerontology, 41*(7), 504-518. <https://doi.org/10.1080/03601277.2014.1003495>
- Zickuhr, K. (2010). Generations and their gadgets. Pew Internet & American Life Project. <http://pewinternet.org/Reports/2010/Gadgets/Report/Desktop-andLaptop-Computers.aspx>

## Appendix A: Interview Protocol

**Topic:** Exploring strategies in Website Development in HCI for Older Adults over 65.

**Sources of data collected:**

\_\_\_ Interviews (face-to-face or phone)      \_\_\_ Documents

**Interview Protocol**

Date and Time		
Location		
Participant ID		
Step 1	Introduction	Thank you for your time and for participating in this interview. My name is Jacqueline Shaw, and I am a Doctor of Information Technology candidate at Walden University. I have worked in and studied the software development industry for over 20 years.
Step 2	Purpose	The purpose of this qualitative multiple-case study was to explore the strategies that HCI website developers use to build interfaces to meet accessibility requirements for older adults over 65.
Step 3	Describe the reason for participation.	The information you provide today, both in interview responses and in any documentation or other sources you may have, will support my study in partial fulfillment of the degree of Doctor of Information Technology from Walden University.

Step 4	Describe the benefit of participation.	The information collected may provide strategies for HCI web developers to build accessible websites directed toward adults over 65. This may lead to the potential for older adults over 65 to have full access to technology that may change their daily lives. It may allow them to use the internet with fewer challenges to connect with services that will open doors to communicate with loved ones and use services such as access to health care and productivity programs.
Step 5a	Discuss ethics	To maintain ethical standards and respect your right to privacy, I am requesting your permission to record the audio of this conversation and keep notes on this entire session starting now. Once the audio recording starts, I will introduce this session using your participant ID <Participant ID> asks you to reconfirm your permission to record and take notes on this session. Is it ok to start? Are you recording now?
Step 5b	Start recording	My name is Jacqueline Shaw, and I am here with Participant <X>; today's date is <Y>. Would you please confirm that I have provided you with

		background information on this study, including the purpose, the reason for your participation, the benefits of participation, and that you approve of my recording and taking notes during this session?
Step 6	Discuss confidentiality	Please feel free to decline to answer any question or stop participating at any time; this is a completely voluntary session. You are free to decline to answer any individual questions or decline to provide. All information you provide will be treated as strictly confidential and will not be disclosed to anyone, including your employer. I request that you avoid using organizational or individual names or any indicators that could be used to identify your organization or individuals in your responses. Any names or comments mentioned in the interview will be removed from the transcripts and not included in the final report. I also request that you do not discuss your participation with anyone until the study concludes. Any information provided in this session will only be used for this study, which will be

		<p>presented in composite form with data from other participants in a doctoral study that may be published. None of any information if you are not comfortable providing the information.</p> <p>Your responses will be presented in individual form.</p> <p>I will keep research records in an encrypted and password-protected format, locked in a safe for five years, after which they will be destroyed. Only I will have access to this data during those five years.</p>
Step 7	Ask if there are any questions and if they want to proceed.	Do you have any questions for me before we start? If not, are you ready to proceed?
Step 8	Transition to the interview	<p>This semi-structured interview is about understanding your thoughts on the topic and questions. I have a few questions outlined for your open and honest thoughts. I am interested in your thoughts about these questions and ask that you not consider any prior relationship I may have with you or the topic in your responses. I may ask for more thoughts or explanations on portions of your responses. As much information as you can provide on your</p>

		thoughts and perspective is greatly appreciated.
Step 9a	Interview	<ol style="list-style-type: none"> <li>1. What is your title and role?</li> <li>2. How long have you worked in this role in designing and developing HCI websites that provide accessibility for adults over 65?</li> <li>3. Do you have a standard for design when designing HCI interfaces to meet accessibility for adults over 65?</li> <li>4. What is your focus on designing special options in terms of frontend interaction for adults over 65?</li> <li>5. What requirements do you consider before designing a website for adults over 65?</li> <li>6. How do you gather information about accessibility options for adults over 65?</li> <li>7. How do you test your accessibility options to be HCI-compliant for adults over 65?</li> <li>8. Do you use older adults to test your finished website?</li> <li>9. How do you gather feedback from adults over 65, and</li> </ol>

		<p>how does feedback play a part in your updates?</p> <p>10. What type of HCI accessibility options focus on adults over 65?</p>
Step 9b	Possible follow-up questions	
Step 10	Gather any secondary data or artifacts from the participant	That concludes the interview portion of the meeting. Do you have any documents, multimedia presentations, or other information that I can collect now?
Step 11	Conclusion	<p>Thank you for your time today. I want to schedule a follow-up interview with you in a few days to ensure I have interpreted your responses correctly. Would that be acceptable? Is there a preferred method of communication for rescheduling?</p> <p>Thank you again.</p>

## Appendix B: Permission to Use Figure 1

