Designing Technology for All: Exploring How eLearning Platforms Support Students with Cognitive Disabilities When Designing Their Web Content

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Abstract. eLearning platforms have become an integral part of education across the United States, from changing how students learn to finding course assistance right from home. However, an important aspect to consider in the design and development of these websites is accessibility and usability. According to the United States' Centers for Disease Control and Prevention, in the U.S. alone, 16 million people have cognitive impairments. Considering these platforms are a growing resource for students who seek educational support, companies behind these platforms should ensure their web content meet standards of efficiency, effectiveness, and satisfaction for all potential users like those with cognitive disabilities. In this poster paper, we discuss how eLearning platforms have designed their web content and question whether they have implemented a universal design that is user-friendly for all. We will analyze the results from our surveys, user-testing, and semi-structured interviews to help define the issues experienced by people with cognitive disabilities when navigating our three chosen eLearning platforms: Khan Academy, Udacity and SoloLearn. These results will in turn provide guided insight on how eLearning platforms should improve their web design.

Keywords: Cognitive Disability, Accessibility, Usability, Functional Cognitive Disabilities, Universal Design.

1 Introduction

With new advances in technology, people across the world with internet connection can access educational resources and tools. As a result, the use of online educational platforms, or eLearning platforms, now make up a multi-billion dollar industry across the world. Also defined as Web Based Training[1], eLearning platforms enable users to learn what they want, wherever they want, and whenever they want; topics range from data science to economics to chemistry. However, accessibility and usability is not often considered when designing eLearning Platforms, or other digital interfaces [14]. According to a report by the Special Olympics, two-hundred million people across the world have cognitive disabilities [15], yet digital interfaces are not adequately providing accessible options [2]. For example, people with low-vision impairments require additional functionality to access digital technology through the use of aids such as color-inversion and magnifying tools [2]. Several eLearning websites do not offer an accessibility option, and most built-in desktop accessibility tools have unwanted side effects such as image-distortion and loss of context [2].

In addition, the learning methods implemented by eLearning platforms are not always effective for people with functional cognitive disabilities. People with disabilities may require different ways to interact with digital content in courses on eLearning platforms. In order to determine better ways to design more accessible eLearning tools, we intend to conduct user-testing where participants interact with the platforms and determine which aspects of the applications are inaccessible and how they can be improved. Previous studies about accessibility in computing have been conducted and they consist of recommendations for developing better interfaces, but they focus on social media platforms. As a result, our data will be paired with previous research-based accessibility design recommendations to design and develop better ways for people with cognitive disabilities to interact with eLearning platforms.

2 Background

2.1 Cognitive Disabilities

Already part of a neglected community of disabilities, people with Cognitive Disabilities (CDs) are invisible or ignored due to their complex and ambiguous condition. A person with CDs experiences mental functioning impairments and/or challenges in communication, self-care, and day to day task performances [4]. Some categories of CDs include autism, Down syndrome, dyslexia, learning impairments, and traumatic brain injury. Since there are abundant types of CDs and great variation within each type, web developers often face challenges when tackling web-accessibility issues pertaining to this community. For example, two people with Down syndrome can have different experiences when accessing web content. One could be highly functional and capable of understanding the majority of the web content while the other may not have the same capabilities despite the same diagnosis [3]. Alternatively, two people with different CDs (ie Down Syndrome and Fetal Alcohol Syndrome) can experience the same challenges when accessing web content.

In order to target the range of issues experienced by people with CDs, developers must look at the functional point of view of CDs. Viewing CDs through a function lense focuses on the effects of one's cognitive disability, such as "memory, visual comprehension, problem-solving, attention, reading/linguistic/verbal comprehension and/or math comprehension [3]." Focusing on the challenges users with CDs face through a functional perspective and not a clinical one allows web developers to identify the impediments. Thus, developers could have a better understanding of what is the root of this complex and ambiguous problem [3].

2.2 eLearning Platforms

eLearning platforms currently make up a $107-billion dollar industry, and by the year 2025, the industry is expected to reach $325-billion dollars [9]. As of 2018, there are approximately 78 million registered Khan Academy users [12]; as of 2017, 8 million learners for Udacity [13] and 5.1 million users have signed up for SoloLearn [11].

These platforms utilize a variety of tools and methods to educate their users. For example, Udacity and Khan Academy rely heavily on videos to show and teach content. On the other hand, SoloLearn uses text-based lessons to convey material. Specifically in computer-science related education, Udacity and SoloLearn also have integrated terminals in their websites so users can interactively run code while Khan Academy has a graphical output console for computational art. In addition, Khan Academy and SoloLearn have traditional fill-in-the blank quizzes where users only have to write snippets of information, while Udacity gives users fewer hints in its quizzes. Although these eLearning platforms offer different educational tools and unique experiences, the accessibility of these learning methods have yet to be analyzed.

3 Research Questions (RQs)

In response to substantial literature that reports the types of changes that were most helpful for creating better user experiences for learners with CDs, we ask the following:

- RQ1. Which features of Khan Academy, Udacity, and SoloLearn required significant time and effort to use for people with CDs?
- RQ2. What are some of the challenges that people with different CDs share when using eLearning platforms. ?
- RQ3. What are the most effective implementation strategies for increasing retention and learning among students who have CDs?

4 Methods

Cognitive Disabilities is a broad and complex spectrum. For our research, we will concentrate on cognitive impairments. In order to simplify our data collection and observations, we will focus on the average time of 2 hours on the computer per week and have previous experience using eLearning platforms.issues that people with cognitive disabilities experience when using these eLearning platforms. Although we are working with a specific community of people with CDs, our findings can help influence design implementations that can benefit all kinds of users. Our main methods for our research will be user-testing through think-aloud exercises and interviews. We will begin the process of collecting qualitative data from students within 20 - 55 years of age since students between this age range show the greatest usage of online learning platforms, often times for independent learning and skill improvements [8]. The sample population for this study will include experienced computer-users with cognitive impairments who spend at least an an average time of 2 hours on the computer per week and have previous experience using eLearning platforms.

4.1 Participant Recruitment

We plan on providing screener surveys through Qualtrics to ensure possible participants meet our requirements of cognitive impairments, computer experience, and age range. Recruitment will span across four research institutions, accomplished as follows: (1) reaching out to local health and disability centers, (2) soliciting interview participation via social media, and (3) snowball sampling for additional participants after each session.

4.2 Procedure

The first part of our study includes creating tasks based on shared features between the three eLearning platforms. We plan to break these tasks into subtasks to help determine how successful the user was in completing the overall assignment. For instance, if the user is asked to look up a course on the website, the task will be broken down to locating the search bar, typing the course name, and clicking search. If a certain percentage of these subtasks are completed, then the user's success rate goes up. We plan to complete user-testing in a quiet, designated area with minimal distractions [17]. Initially, we will let them freely explore the website so they can get a sense of the platform's features. In order to help people with other functional impairments they may have, like writing difficulties, tasks that include text-input will have a provided guide sheet with the text written for them. No additional assistance will be provided other than clarification, but participants will be encouraged to verbalize their thoughts and feelings. Each task will be repeated for a minimum of two trials. We will also screen record, audio record, and simultaneously take notes of any observations we have on the trial. At the end, we will interview each participant about their usability experience when navigating through the assigned tasks [10]. We will transcribe the audio recording of each interview and create a code book to summarize the most relevant findings we learned from each participant.

4.3 Data Analysis

Through user-testing, we intend to collect data on interaction, assistive tools, and satisfaction. We will analyze our qualitative data inductively through a thematic approach to identify common patterns in the user-testings conducted.

5 Summary

Our research is meant to extend design recommendations and create stricter guidelines for accessible digital educational tools. Our data collection and analysis will help us create in-depth accessibility design-guidelines, which will be paired with previous research and design recommendations for accessible computing. Ultimately, we are working towards the paradigm of "design for all" and creating intelligent, universal interfaces and tools so people with disabilities can access digital technology. Designing for all is a universal approach to design implementations that will not only benefit underrepresented communities like people with CD, but all communities regardless of need. As a result, we aim to expand accessibility in computing and improve cognitive usability with digital technology. We hope our future research will inspire others to implement their versions at universities and in academia, as well as by educational companies and the government for the public.

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