Accessible Web Development: Design Brief

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Problem Statement and Background

Web development includes a complex and constantly evolving set of technologies that are built on an understanding of the three core web languages: HTML, CSS, and JavaScript [6, 14]. In the United States, there is significant growth predicted for Web Development and adjacent jobs, with a projected increase of 8% over the next 10 years [3]. Along with growing job market opportunities in web development, there is an unprecedented shift towards remote web development education (both formal and informal) [9].The COVID-19 pandemic has accelerated this shift to remote learning and created new pressure for individuals and businesses to upskill and circumvent financial disruptions caused by a loss of work [8].

Although employment in web development is on the rise [3], disabled people are significantly underrepresented [4]. Blind developers often face accessibility issues in learning and practicing programming [1, 2, 13] and interface design [11]. However, remote education has the potential to make these sought-after skills more accessible to blind people, especially if usability and accessibility best practices are implemented [16]. We believe that if more blind people brought their expertise and perspectives to web development, this would contribute to the democratization of the web and accessibility for all. However, accessibility and usability are often not prioritized in remote education, and only considered after a disabled person tries to access materials and encounters accessibility issues [5].

The demand for web skills and the need to support the accessibility of online educational resources during the pandemic are the primary motivators of this work.

Methods and Approach

To address a lack of remote, accessible web development training, the project included the design, implementation, and evaluation of accessible Web Development resources and materials.

The workshop website was developed and hosted using the domain name webworkshop.club. The site was built to meet WCAG 2.1 requirements, and linked external resources were first evaluated for use with screen readers by the first author. The website navigation includes

Home, Intro, HTML, CSS & Design, JavaScript, and Resources sections. Pacing is not determined by the structure of the site, and it can be used to teach units over longer or shorter periods of instruction, depending on student learning.

Each unit contains code snippets, activities, and links to external tools and websites that provide further material/reading. For example, the unit on CSS includes links to downloadable our tactile diagram files (see Section 3.3.1) and several web-based tools to help teach color theory and pick color combinations (a web-based Color Namer Tool [10], WebAIM's Color contrast checker tool [14], a Color Encyclopedia [6] and palette creation tool [12]) and troubleshoot syntax issues (W3C's CSS syntax validation tool Jigsaw [15]). This was included to aid student exploration and experimentation with RGB values to create colors, and to learn the connection between these values and web color names.

The Resource page contained internal and external links to additional information and was organized by headings screen reader Workflow Documentation, HTML, CSS, and JavaScript, Accessibility and General Web Resources.

We also designed resources and materials through remote collaborative design between first author (Claire Kearney-Volpe) and second author (Chancey Fleet). We created tactile diagrams to convey visual design concepts in the Design and CSS unit of the curriculum. To design these tactile diagrams, the first and second authors engaged in remote collaborative design sessions where the second author had access to a braille embosser and could quickly evaluate the graphic. We conducted four remote iterative design sessions using Zoom (a cloud-based video conferencing service) to develop tactile diagrams for this curriculum. Our process involved the first author creating designs in Illustrator, exporting them to .png format, and emailing files to the second author. Then the second author embossed graphics just before remote sessions, during which she used descriptive language about the diagrams' tactile qualities and provided general design feedback that informed real-time changes to Illustrator designs.

To evaluate the curriculum and diagrams, we held a 9-session workshop and students were invited to participate in qualitative exit interviews to discuss their experiences as well as their desire/sense of preparedness to pursue web development further.

Description of Final Approach and Design

Our collaborative design process helped identify important tactile design features and to create tactile diagrams used as part of the curriculum. All tactile diagrams were given descriptive titles on the top-left, and orientation markers (three diagonal lines) on the top-right. To communicate design concepts, our iteration process guided us toward strategies for labeling, distinguishing objects using background colors for texture, and sizing decisions to make elements prominent. The resulting diagrams were used to support learning concepts related to Font Type, Font-Family, Sizing, Alignment and Position, and Color Theory.

This collaborative design process yielded the following 8 tactile diagrams: 1) Font types represented by sans-serif and serif letter “F”s; 2) Font-families represented as tactile print of the word “Typography"; 3) Font-size represented as tactile print of the word "hello" in ascending size from 12-72pt font; 4) A tactile representation of the box model to demonstrate relationship between elements, border, padding, and margin; 5) The layout of elements on the Google homepage (centered or distributed horizontally); and 6) The Google homepage without alignment (all elements on the google homepage are aligned left in a column); 7) A color wheel with full color names and legend in braille to explain how shapes (square, circles, and triangles) are used to convey primary, secondary, and tertiary colors; and finally, 8) A color wheel with abbreviated color names in braille, and connecting lines to highlight color complementary color relationships (Figure 1).

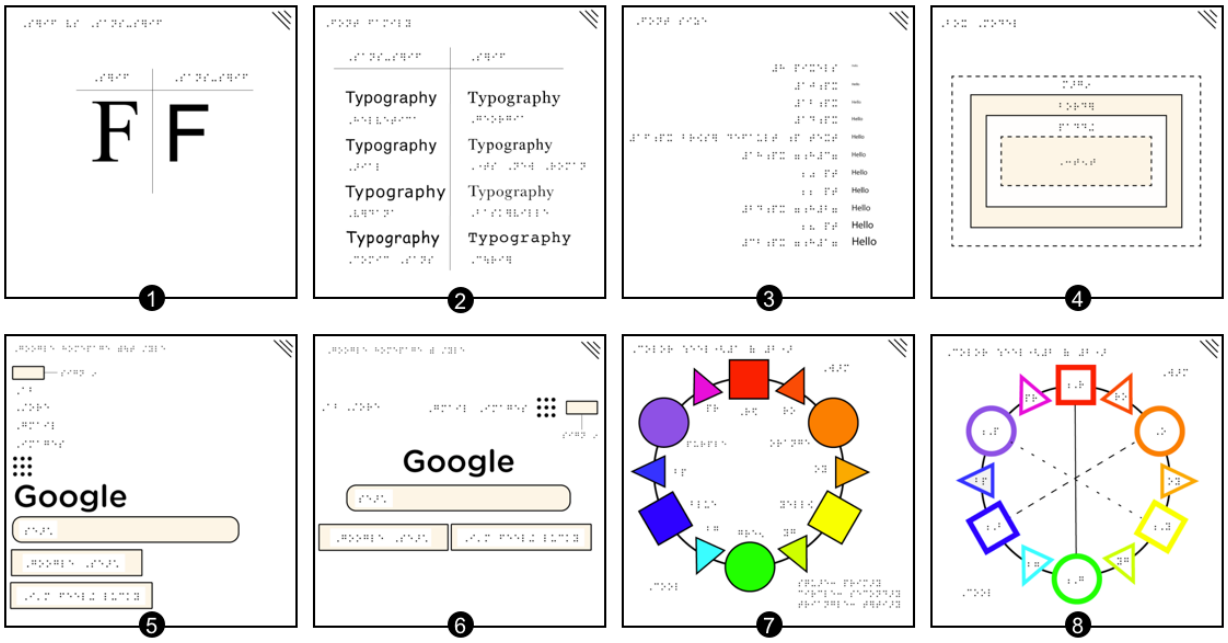

Figure 1. Tactile Diagrams. 1= Font Type, 2= Font-Family, 3= Font-Size, 4= Box Model, 5-6= Google Homepage with and without positioning and alignment, 7= Color wheel with legend, and 8= Color Wheel with abbreviated color names and complementary color connector lines

Outcome

All students were able to make and publish websites and enjoyed the workshop content, discussions, and activities. Exit interview participant responses (n=10) to the curriculum and materials were unanimously positive and students reported that participation gave them a sense of empowerment and understanding over a previously mysterious/out of reach subject.

Generally, all participating students felt that the tactile diagrams were helpful. In exit interviews, they felt the tactile diagrams made it hard to grasp visual concepts more concrete.

For example, P2 described CSS as "*ephemeral*" and "*elusive,*" but with tactile diagrams, she felt that "*the elusive thing was more tangible…to feel what it would look like. It was a revelation*." P10 said that the tactile diagrams "*really helped to solidify things*," and P7 described them as "*easy to understand and follow.*" Students found the Color Wheel, Font-Type, and Google Homepage tactiles to be the most helpful. They felt that the Color Wheel diagrams were helpful because they demonstrated relationships between colors, and basic concepts using shapes (primary, secondary, and tertiary). The Font-Type diagram was appreciated for its tactile clarity (could feel the differences), and side-by-side comparison. The Google Homepage diagrams were appreciated for their relatability/familiarity of the page example, and a clear demonstration of the difference between screen reader experience (linear and like the example without alignment), and sighted user experience about how content is spatially organized when a website is rendered using CSS spacing and alignment properties.

Cost

Total cost: $55.00USD.

Items: $50 for embosser paper, and $4.99/annual curriculum domain name fee

Significance

Although the COVID-19 pandemic was a catalyst for the remote format of the curriculum and materials, we believe it can continue on in this format with continued success. The use of tactile diagrams may present a challenge given this format; however, we feel they are necessary ingredients and contributed to positive outcomes for students.

Based on the interest we received from students eager to participate in this workshop, it is clear there is strong demand for approachable, accessible web development education in the blind community. Student enthusiasm for the subject and plans to take their learning forward is a hopeful step toward the democratization of the web, and accessibility for all. Although there is much work to be done to improve the accessibility of web-development education, there are many interesting opportunities to leverage existing technology to teach, learn, and practice web development with a screen reader.

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