

Running head: CREATION OF A STEM INFLUENCER REPOSITORY

**Creation of a Science, Technology, Engineering, and Mathematics Influencer Repository
for High School Girls**

A Master's thesis project
presented to the Department of Communications and Information Design
in partial fulfillment
of the requirements for the Master of Science degree

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Certificate of Approval

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Abstract

When utilized strategically, Universal Principles of Design, and more specifically, User Experience Design, can enhance the individualized impact and effectiveness of interactive digital resources. This paper will explore the gender disparity in science, technology, engineering and math STEM education and professions, factors that influence the representation of girls and women the STEM pipeline, and a technology solution that addresses one specific factor for the underrepresentation of females in STEM: the lack of visibility of female role models in these fields. In creating a mobile website prototype for a social media repository of female professionals in STEM, this paper will also examine the impact of social media “influencing” on teenagers, and the ways in which design principles can be implemented to promote an intuitive and highly personalized website experience that allows high school girls to see their own identities and outlooks represented in STEM professions.

Keywords: STEM, career choice, college major choice, mobile website, social media, Adobe XD, influencer, role models, science education, engineering education, female representation in STEM

Literature Review

The lack of professional female role models in science, technology, engineering, and math STEM careers, in terms of actual representation as well as perceived visibility, is an issue that negatively impacts high school girls' interest in and likelihood of choosing STEM majors in college Dasgupta Stout, 2014 , further perpetuating the STEM gender imbalance in professional fields. This literature review will first set the stage with current data on gender representation in STEM fields in the United States by reviewing education and labor data from government bureaus and professional organizations. Next, we will explore empirical research conducted by STEM education experts to define the importance of representation and role models in efforts to broaden participation and diversity. These insights will define our target audience and the purpose of the design that will be proposed in this paper, and make the case that there is a need for the proposed media.

In an era where social media serves as the primary modality of information consumption for young adults Google, 2012 , STEM professionals who can serve as role models have an accessible and far reaching platform to share their stories with the next generation of professionals. Literature from the fields of media study, psychology, sociology, and marketing will provide insight into the phenomenon of social media influencing, which will inform the prototype design of a centralized repository website to easily identify social media accounts which fit the female STEM influencer framework.

While there are multitudes of such social media accounts already in existence, creating a centralized repository website would allow the primary audience to easily browse, filter, identify, and subsequently follow role models per their own personal criteria. I will examine literature in the areas of information design and more specifically, User Experience Design UXD , that point toward practices that enhance individualized engagement. A prototype design that relies on best

practices in UXD will also serve as an easy-to-share resource for educators, parents, and mentors.

Due to the limited scope of this project, this literature review will not cover the technological aspects of website design such as coding and web development, nor database architecture. Additionally, this literature review will not discuss specific recommendations for social media influencers to enhance their impact. Ultimately, the website prototype will feature a diverse pool of female STEM professionals using an array of styles, techniques, and social media channels to share their own authentic experiences in whichever way they see fit.

Setting the stage: An overview of the gender disparity in STEM education and professions

According to the United States Department of Commerce, women comprised 47% of the nation’s workforce in 2017 Beede, Julian, Langdon, McKittrick, Khan Doms, 2017 . However, when referencing jobs in the areas defined as science, technology, engineering, and math STEM , women comprised only 24% of all workers compared to 76% men Noonan, 2017 .

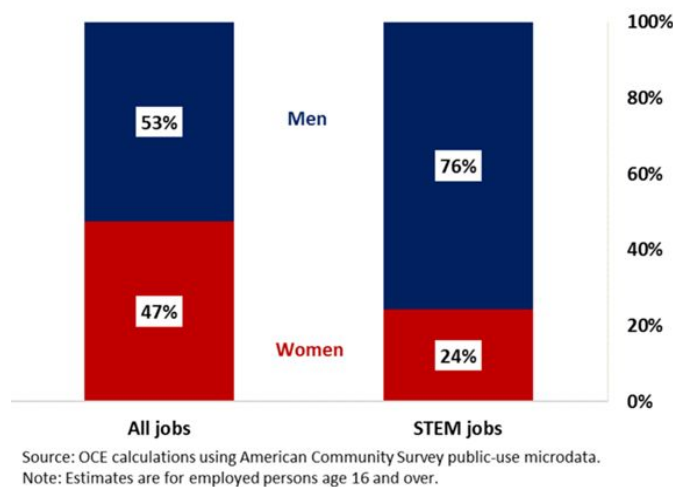


Figure 1. Gender shares of total and STEM jobs, 2015 (Noonan, 2017)

While gender bias in the workplace is among the many factors that contribute to poor retention of women in STEM jobs after they have begun their professional careers Williams, 2015 , tracing the pipeline backward reveals a significant gender disparity in STEM college degrees granted. Figure 2, based on the Integrated Postsecondary Education Data System completion survey, shows that over the past decade, STEM degree attainment by women has remained stagnant or in decline in most disciplines American Physical Society, 2017 . In 2016, women earned only 21% of all bachelor's degrees across all engineering disciplines and 19% of bachelor's degrees in computer sciences, as demonstrated in Figure 3 National Student Clearinghouse Research Center, 2017 , despite earning more than half of all bachelor's degrees across all disciplines. Some specific disciplines present an even larger gap: in 2016, only 12% of aerospace engineering, 12% of electrical engineering, and 17% of mechanical engineering bachelor's degrees were awarded to women Bossart Bharti, 2017 . Though physical and life sciences areas of study such as biological sciences tout strong representation of women, who comprised 60% of four year degree earners in 2016, the significant drop-off of female representation in jobs requiring a bachelor's degree in biology illustrates a retention issue, stemming from a variety of social factors. Across all majors, the U.S. Department of Commerce finds that women who do receive STEM degrees "are less likely to work in STEM jobs than their male counterparts" Beede et al., 2017, p. 1 .

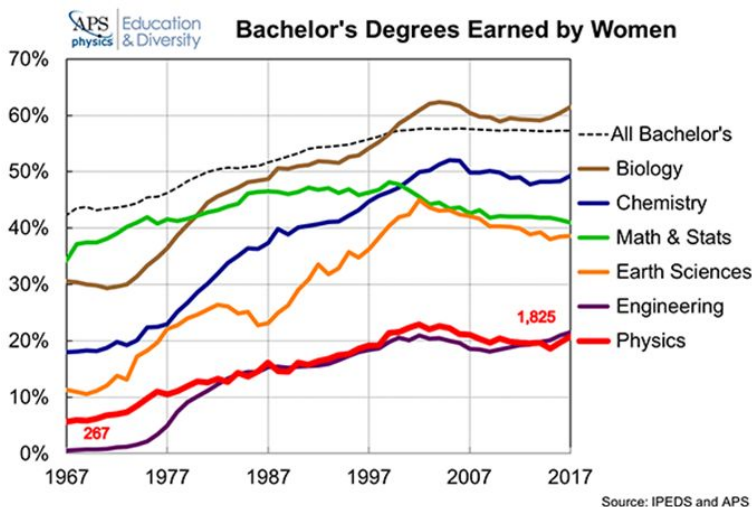


Figure 2. Bachelor's degrees earned by women, by major. (American Physical Society, 2017 .

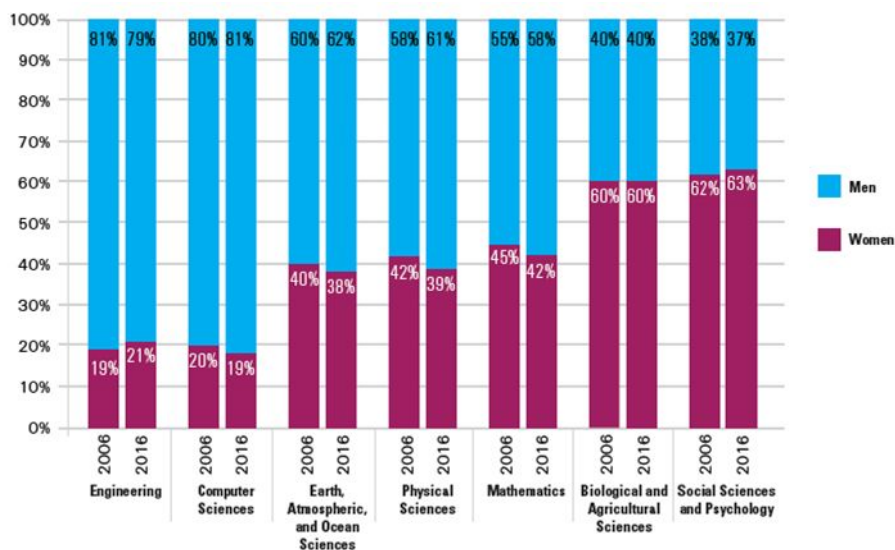


Figure 3. Gender distribution of bachelor's degrees in science, math, and engineering disciplines, 2006-2016. (National Student Clearinghouse Research Center, 2017

Why does female representation in STEM matter?

The gender disparity in STEM education, and subsequently, in STEM professions in the United States has far reaching economic and social ramifications, and thus deserves attention toward creative solutions such as the one proposed in this paper. According to the American Association of University Women AAUW 2020 , supported by data from the Pew Research

Center, a “typical STEM worker earns two-thirds more than those employed in other fields.” Because women are represented so poorly in some of the highest-earning STEM occupations, including computer science and engineering, women miss out on lucrative opportunities, fueling the expansion of the gender wage gap in the United States. Pursuit of STEM careers enhances “women’s economic security,” as much of the future job growth in the US will require education and/or experience in the fields of science, technology, engineering, and mathematics AAUW, 2020; Dasgupta Stout, 2014 .

From a global perspective, it is important to note that the STEM gender gap is a phenomenon largely unique to the United States Robelen, 2012 . One of the key indicators for a nation’s strong economic competitiveness in the global economy is the ability to innovate World Economic Forum, 2018 . Research on approaches to complex problem solving illustrates the value of diversity within teams of problem solvers: diverse representation on teams yields greater and more innovative outcomes than both individual problem solvers and heterogeneous teams, even when the diverse team is composed of lower-performing “individual agents” Hong Page, 2004 . In addition to the benefits of *enhanced* innovation that result from the proportionate representation of women in STEM problem solving teams, women should be actively involved in devising solutions that impact them directly-- as individuals, and as a collective half of the general population Barratt, 2018 . For example, two notable blunders in recent technology innovation history where women were not provided a seat at the decision makers’ table, include the development of seatbelt technology that only accounted for the physical attributes of the average male body Imafidon, 2018 , and the creation and rollout of a Fitbit menstrual tracking device that inhibited users from tracking a period that extended more than 10 days, despite many women experiencing periods that last longer FitBit Community, 2018 . Though these are just two conspicuous examples, the inclusion of women in the

innovation of new knowledge and technologies is not only a good practice for productivity, but an ethical one.

Lastly, and perhaps most relevant to the website prototype that will be proposed in this project, the underrepresentation of women in STEM fields is self-perpetuating. Because the lack of visible role models allow unchallenged stereotypes about STEM careers and identities to permeate STEM education recruitment efforts, the prospect of increased representation among the next generation remains unpromising unless creative interventions are sought (Drury, Siy Cheryan, 2011). In this next section, we will explore how lack of female STEM role models serve as a barrier to female pre-college populations in the US.

STEM pipeline influence factors before and at the high school level

In order to create a technology solution that addresses the gender disparity in STEM professions, it is critical to recognize the complex social factors that impact girls' interest in STEM from early childhood through college entry. In addition to the early socialization of academic interests by parents and educators in childhood (Simpkins, Davis-Kean, Eccles, 2006), these influential figures largely fail to make the case that STEM careers are creative "helping" roles that have a positive societal impact. STEM roles are misperceived to hamper "communal goals," where "service professions" such as social work, nursing, and teaching, human resources, on the other hand, are perceived to promote "communal goals" (Diekman, Brown, Johnston, Clark, 2010). Though these stereotypes about the impacts of STEM roles are inaccurate, cultural values that socialize girls and women to self-associate with career values such as altruism and interpersonal connection over challenge, power, and risk-taking do impact girls' likelihood to pursue STEM interests through high school, and ultimately choosing a STEM major in college. Introducing high school students to a wide array of careers and

personal stories could help dismantle the stereotypes about the day-to-day nature and large social impact of STEM roles.

STEM role models

Educators, researchers, and STEM professionals agree that exposing girls to female STEM role models who look like them “over and over and over again” is critical to recruiting women into STEM majors in college, and ultimately STEM careers Milgram, 2011 . The emphasis on continuous and repetitive exposure makes social media channels, and the way their content is consumed, a potentially effective modality to convey messaging about STEM identities.

According to the National Alliance for Partnerships in Equity NAPE, 2020 , one of the most effective avenues to encourage pre-college students of all genders “to consider nontraditional careers is to introduce them to diverse role models, particularly role models with whom they are able to relate by gender, ethnicity, socio-economic status, location, etc.” For female students specifically, introductions to STEM professionals have the power to “transform popular image and belief of who ‘belongs’ in STEM” NAPE, 2020 . Seeing personal traits represented in these career fields enhances childrens’ and adolescents’ “STEM identity,” defined as “one’s identity as someone who understands, applies, and can contribute to STEM” CAISE, 2018; Drury, Siy, Cheryan, 2011 . STEM identity is deeply intertwined with self confidence, professional role confidence, and self efficacy. This emphasis on highlighting diversity in STEM professionals’ identity traits is a factor that will heavily impact the structure and functionality of the proposed mobile website prototype.

Social media

Merriam Webster n.d. defines social media as “forms of electronic communication such as websites for social networking and microblogging through which users create online communities to share information, ideas, personal messages, and other content such as videos .” Over the past decade, social media as a broad category of interactive platforms has evolved from being used primarily as a networking tool, to a much more complex influence in the daily lives of its users: Social media platforms serve as a primary source of new knowledge consumption Guzman, 2016 .

Social media use among young people

In 2015, 92% of adolescents aged 13 to 17, reported using their mobile devices to connect with web based applications daily, with 24% reporting that they go online “nearly constantly” Lenhart, Smith Anderson . In the same year, 71% of teenagers in the United States regularly utilized more than one social media application Lenhart et al., 2015 . Though social media usage trends are constantly and rapidly evolving, sometimes seemingly overnight, in 2016, Snapchat and Instagram were the most heavily utilized social media applications among young adults aged 13 to 17 Associated Press-NORC Center for Public Affairs Research, 2016 .

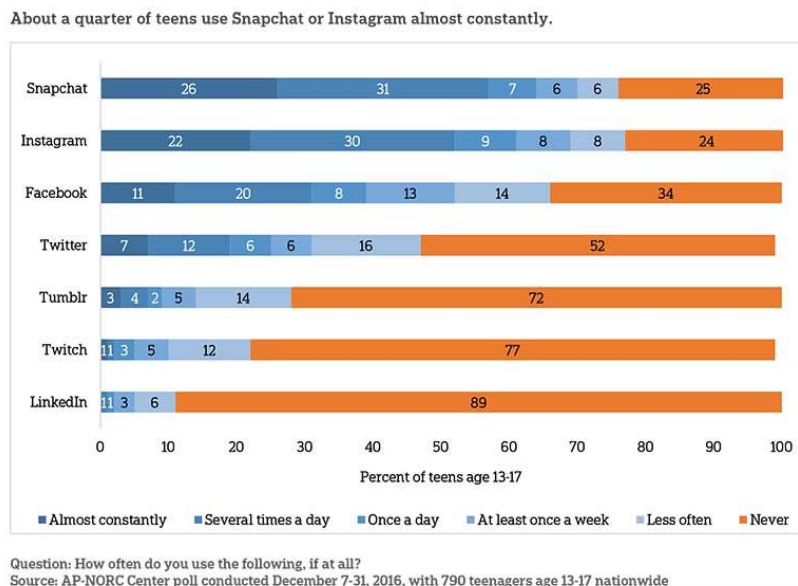


Figure 4: Frequency of teen social media use by application. (Associated Press-NORC Center for Public Affairs Research, 2016)

The uses and gratification theory posits that people are active consumers of mass media, as opposed to passive users, and that they select and utilize specific types of media to satisfy specific needs Severin Tankard, 1997 . According to a Pew Research survey, among the uses of social media that have a “mostly positive” perceived effect on their lives, teen users cited “Easier to find news/info,” “Keeps you entertained/upbeat,” “Getting support from others,” and “Learning new things” as main reasons Anderson Jiang, 2018 . These reasons justify efforts to actively promote female STEM influencers’ social media accounts: users logging in to their social media accounts are prepared to learn something new, engage in positive content, and receive help and encouragement from others.

Social Media Influencers

A social media influencer SMI is defined as “a social media user who has established credibility in a specific industry” and who “has access to a large audience and can persuade others by virtue of their authenticity and reach” Pixlee, n.d. . As a relatively new phenomenon,

most research on social media influencing is rooted in the marketing industry and focuses on the power of influence in selling products and services. Furthermore, most existing research on SMIs does not thoroughly integrate social nor communication theory, inspiring strategic communications experts to call for “further substantial and coordinated research initiatives” Borchers, 2019 .

According to Olapic 2018 , a key trait of an SMI that is well received by their audience is their perceived authenticity. Within the context of this project, creating a website prototype that showcases the authenticity of female STEM professionals in both career-centric and personal spheres stands to maximize the influence on viewers, as they will have a window to connect with real life experiences over highly curated marketing content.

Website Design

Web design as a science and an art has a fairly recent history. Though it is highly technological in nature, many of the best practices utilized in the web design field are rooted in areas such as graphic design, user experience, and multimedia design Web Design Museum, 2020 . To inform the development of a prototype webpage later in this project, this literature review will focus on two distinct sets of design principles that can be applied to web design: the Universal Principles of Design, and User Experience Design UXD .

Universal Principles of Design

The Universal Principles of Design illustrate the cross-disciplinary nature of design. These “laws, guidelines, human biases, and general design considerations” are based on research in psychology, anthropology, and human factors research, and are intended to be applied to a variety of design disciplines Lidwell et al., 2010, p. 12 . For the purposes of this

project, this literature review will highlight a few of the principles that closely align with the purpose and functionality of the prototyped STEM influencer repository webpage.

Prototyping

For the purposes of this project, prototyping the repository website will serve as a cost effective way to “explore preliminary design ideas” Lidwell, Holden Butler, 2010, p. 194 . By producing a semi-functional model, I will be able to visualize the basic structure and navigability of the proposed website, and will be able to assess areas for improvement for future iterations of the page. The principle of concept prototyping, specifically, allows for “evaluation by a target audience” Lidwell et al., 2010, p. 194 . While the scope of this project does not involve evaluation by our primary nor secondary user bases, a prototype will address the research-justified primary design requirements that relate most closely to the social problem they seek to address.

Hick’s Law and the 80/20 Rule

Hick’s Law is a design principle stating that the more options a user is presented with, the longer it will take for the user to make a decision Lidwell et al., 2010 . In web design, implementation of Hick’s Law can take many different forms. “Scaling down the number of options available” may involve applying drop-down menus with limited navigation choices, providing only one or two action buttons, or limiting search functions to a single field Cao, 2013 . In prototyping the STEM influencer repository, streamlining navigation functions and limiting filtering choices to pre-populated labels will promote quick navigation and limit complexity in using the tool.

Consideration of the 80/20 Rule further argues for the importance of minimizing user options. In the context of website design, the 80/20 rule suggests that “80 percent of the

product's usage involves 20 percent of its features" Lidwell et al., 2010, p. 14 . This principle can be used to guide the "real estate" occupied by various functions of the website prototype. If this prototyped website were to be brought into production, a valuable research method would be to observe usage of the various functions of the website and prioritize placement and visibility of those most frequently used.

Color

Color is a universal design principle that encompasses an entire collection of sub-theories that guide its use. Thoughtful use of color in the design of the prototype website will contribute more than just aesthetic appeal. The selection of a color scheme and the way that colors are assigned to various elements on the webpage can promote readability, define hierarchy among content, and influence the mood of the viewer Lidwell et al., 2020 . According to Sharp and Preece, prioritizing yet appropriately using color, along with size, shape, alignment, and proximity in web design can "minimize unnecessary complexity and cognitive load" 2019, p. 553 . Using color alone to identify functionality, however, is poor practice in creating accessible designs, as individuals with visual impairment may either not be able to differentiate the visual indicators, or will not be able to hear the meaning of the color using a screen reader U.S. Web Design System, 2020 .

Garbage-In Garbage Out

The garbage in-garbage out principle, also referred to as GIGO, recognizes that user inputted information that is of the wrong type or quality results in poor quality outputs Lidwell et al., 2010 . While the phrase and its inherent principle are rooted in the early days of data computing Quinon, 2005 , addressing this concept will justify a filtering mechanism on the prototype website. Utilizing pre-defined filtering categories that house terms which match up

with the tags assigned to related content will serve as an input constraint. Lidwell et al. identifies affordances and restraints as primary strategies that “structure input and minimize the frequency and magnitude of garbage output” 2010, p. 112 . For the purposes of the prototype website, providing a pre-defined filtering menu as a restraint will eliminate the potential for typos or unrecognized search terms as inputs.

Forgiveness

In addition to the input restraints justified by the garbage in-garbage out principle, implementing mechanisms that promote good affordances, and the ability to reverse actions allow users to “minimize the negative consequences of errors when they do occur” Lidwell et al., p. 104 . Using checkboxes on the filtering menu, coupled with a “filter button” is an example of an affordance that nudges users to select multiple criteria before actively submitting their filter request. Integrating a “clear filter” option promotes the reversibility of actions in the event of an input error, or if the user simply wants to use different filtering criteria. Additionally, relying on conventional patterns in terms of website visuals and verbiage “shorten[s] the learning curve for users,” leading to fewer errors Cheung, 2017 . For example, the website prototype could display hyperlinks as underlined text in a different color, tabs as labels situated in a horizontal row, and vertical scroll bars as a moveable square along a thin column with “up” and “down” arrow buttons at the top and bottom.

User Experience Design

Allabarton 2016 defines the focus of User Experience Design UXD as “enhancing user satisfaction by improving the usability, accessibility, and pleasure provided in the interaction between the user and the product.” In many web and application development firms, UX designers are highly specialized researchers, designers, and analysts who guide the

development, testing, and implementation of new digital products Allabarton, 2016 . While encompassing the full scope of duties of a UX designer is not realistic for this project's objective, this literature review will explore a few key aspects of UXD that will enhance the functionality of the website prototype and ensure there is a close relationship between the goal of the proposed resource, and the design that houses it.

Responsive web design

The concept of *responsive web design* was coined by Ethan Marcotte in 2010 in response to users' evolving web viewing behaviors as cited in Firdaus, 2013 . Specifically, the common user practice of viewing websites across multiple browsers e.g. Google Chrome, Firefox, Safari, and Internet Explorer and multiple devices e.g. desktop computers, tablets, and phones; iPhone vs. Android prompted web designers to detach from the use of static grid design structures on webpages, and to adopt flexible structures that adapt to the viewing environment offered by each browser or device type Firdaus, 2013 . Coates and Ellison 2014 identify "retain[ing] quality and parity when designing for multiple platforms" as one of the most significant challenges that information designers face, and that "designing with limitations in mind" can help keep content aligned with the capabilities of the viewing platform.

Creating a mobile responsive website to house the STEM influencer repository is critical for two reasons. First, the majority of organic web searches in the United States are carried out on a mobile device: in 2019, 60% of searches were carried out on a smartphone or a tablet, as opposed to a desktop or laptop computer Statista, 2020 . While this data is not broken down by demographic, it is possible that mobile searches by our target audience, high school girls in the U.S., may be even more concentrated based on the statistics regarding their age group's heavy use of mobile devices discussed earlier in this paper. Second, because the purpose of the

proposed website is to connect users to the social media accounts of STEM influencers, navigability on a mobile device would create a more seamless transition between “explore” and “follow,” as some social media applications, such as Instagram, offer only limited functionality when viewed in a web browser Walker, 2020 .

Customization vs. Personalization

Customization, claims Even 2015 , allows a user to manipulate the settings of an app, website, or program to suit their desires or needs. Personalization, on the other hand, applies when a product adapts itself “based on the knowledge it already has about you” without requiring the user to provide continuous feedback Even, 2015 . While the shift to personalization is a newer and more sophisticated approach for designers e.g. Spotify suggesting new songs based on your listening patterns, receiving Amazon offers based on your browsing and purchasing habits, Yelp suggesting restaurants based on your current location , there may be some instances where customization is more suitable. For the proposed prototype, I would argue that customization would be the more appropriate avenue to present profiles from the STEM influencer repository. The target demographic, high school girls, are not experts in the area of STEM fields and this tool is intended to encourage the active exploration of previously unfamiliar people, career choices, academic degrees, and special interests. While personalization could be useful in some instances, for example, demonstrating to a Black high school student that despite low visibility and representation, there are many Black STEM professionals sharing their experiences on social media. However, for a white student using the website, automatically limiting entries based on their own identity presents a pool of entries with little or no racial diversity. While race-ethnicity is just one possible identity category by which influencers can be filtered, assuming users’ preferences based on previously collected

information is counterintuitive to efforts to introduce users to ideas they had not considered previously.

Tags and filters

The use of tags and filters promotes customization and allows users to hide elements of a design that they are not interested in exploring at that time, adhering to the recommendations of Hick's Law. Tagging, or using metadata to associate an entry with other pieces of data, such as a characteristic or descriptor is a web design practice frequently used in E-Commerce that allows shoppers to view items that adhere to user inputted preferences Laja, 2019 . Tagging is also used frequently in the field of library sciences to develop catalogs that are searchable in multiple ways Gerolimos, 2009 . Best practices in designing filtering interfaces promote grouping filter options into categories, allowing multiple selections, and repeating the selected filter items elsewhere on the interface so there is no question about which combination of selections are activated Cunha, 2017 . One example of an E-Commerce interface that incorporates each of Cunha's recommendations in a desktop format is the West Elm online shopping module Figure 5 .

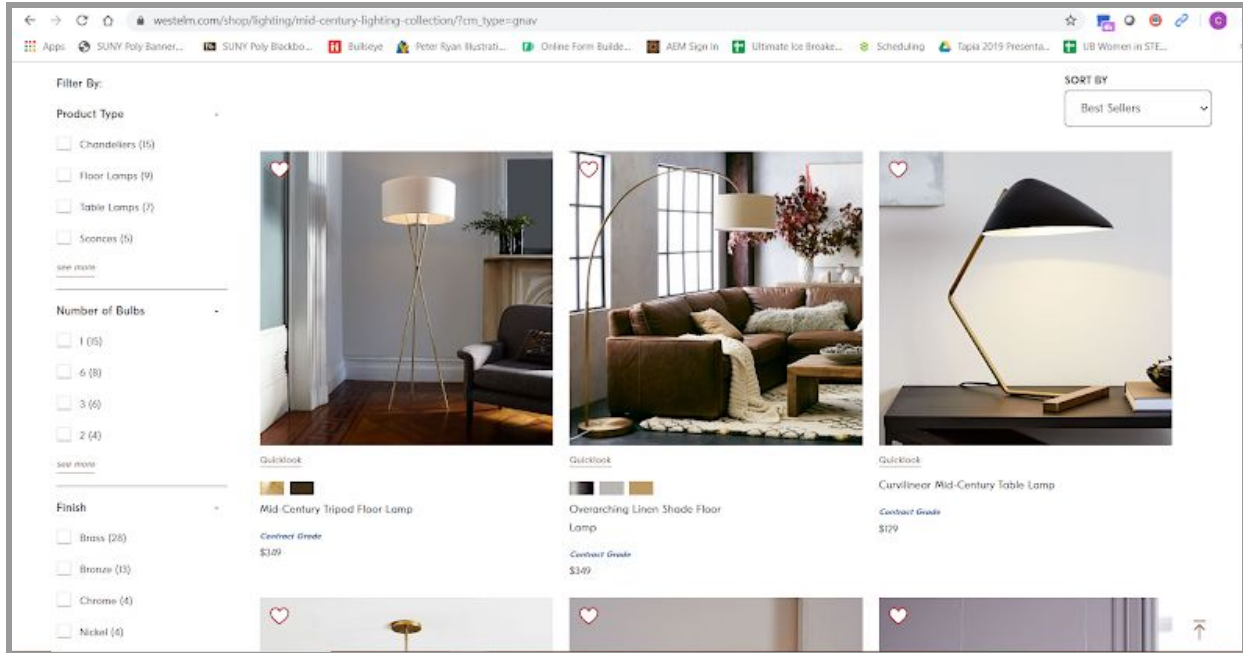


Figure 5. Sidebar filtering functionality on West Elm website. (West Elm, 2020)

In order for filters that rely on tags to function properly, data must be structured appropriately on the back end. Per the garbage in-garbage out principle, a well thought out mechanism to organize database entries will yield a more satisfying user experience. One common-use instance where the use of an organized tagging system appropriately categorizes data is the Mailchimp mailing list upload interface as illustrated in Figure 6 Mailchimp, 2020 . As a mailing list owner adds new members to a mailing list audience, they may attach tags that group members with other like-members. Members with specific tags may be filtered and viewed in this listview, or may be recalled as a group when carrying out various functions of the Mailchimp software, such as sending a newsletter to only members tagged with Conference Lead, or creating a new audience Mailchimp, 2020 . While the scope of this project does not delve deeply into the science of data structures, a basic understanding of tagging and filtering principles is necessary to guide the design of the mobile website interface.

Filter by Tags ▾		View Segment ▾		New Segment			
▼	Email Address	First Name	Last Name	Tags		Email Marketing	
<input type="checkbox"/>	j.roberson@jsu.com >	Joshua	Roberson	Out of state	Shops sales	Subscribed	
<input type="checkbox"/>	m.garza@mailme.com >	Mary	Garza	Out of state	Influencer	Subscribed	
<input type="checkbox"/>	j.moody22333@gmail.com >	John	Moody	Shops sales		Subscribed	
<input type="checkbox"/>	mspark@hathaway.edu >	Myra	Sparks	Conference Lead	Shops sales	Subscribed	
<input type="checkbox"/>	s.fox@foxmail.com >	Samuel	Fox	Conference Lead		Subscribed	
<input type="checkbox"/>	vtodd@aol.com >	Valeriya	Todd	Out of state		Subscribed	
<input type="checkbox"/>	rtucker456@gmail.com >	Rodney	Tucker	Out of state	Likes mailers	Yelper	Subscribed

Figure 6. Mailchimp audience management interface featuring one or more tags per contact. (Mailchimp, 2020 .

Summary

The underrepresentation of women in STEM fields is a deep rooted social issue that has challenged industry and education fields for decades. However, in the 21st century, the overwhelming adoption of social media by young people as a tool for learning, engaging, and connecting presents a unique opportunity to address many of the pipeline issues that researchers define as barriers to STEM entry for women. Among these issues, lack of exposure to STEM role models who can help dispel myths about STEM, emphasize the creativity and diversity of experiences within STEM careers, and share encouraging messages for aspiring scientists, mathematicians, and engineers is one that can be effectively addressed through social media engagement. Utilizing best practices in design that foster a customized and streamlined user experience can guide the creation of a centralized resource focused on encouraging high school students to explore careers and educational paths, and to identify female role models in STEM with interests or identities in common.

Methods

To answer the following research questions, I utilized Adobe XD to create a mobile website prototype that serves as an interactive repository for female STEM influencers who have social media accounts. This project seeks to answer:

- 1 How can the design and content of a STEM Social Media Influencer Repository for high school girls address the perceived lack of visibility of professional female STEM role models?
- 2 How can the integration of the Universal Principles of Design in a STEM influencer repository be used to promote user engagement with the website and its integrated social media feeds?
- 3 What User Experience Design principles can enhance website navigability and unique user preferences to deliver a personalized experience?

The mobile website preview, though not complete in its functionality, demonstrates the general visual design, structure, and interactive features. Each display screen included in this section will be supplemented with justification of the design principles that were integrated.

Assumptions

This prototype features a limited sample of profiles based on real female influencers in STEM. For the sake of exhibiting the functionality of this tool, some profiles were supplemented with sample details when information was not available. This prototype was created based on the assumption that all metadata for each featured influencer would be readily available on the web, though as will be discussed in *Limitations* and *Considerations for future development*, a

longer development timeline and wider project scope could accommodate additional measures for sourcing more complete website content.

Lastly, this prototype illustrates the range of operations of the STEM influencer repository as viewed through a web browser on an iPhone X, XS, or 11 Pro, but the viewer can assume that the page is fully responsive and will adapt to the display size and accommodate the user behaviors associated with other devices, whether mobile or desktop.

Limitations

This prototype is conceptual in nature. I acknowledge that my experience and knowledge in computer science, data architecture, and the sociology of STEM fields is limited and future iterations of this project would incorporate multidisciplinary skill sets. Additionally, given the time limitations of this condensed semester, the development of this prototype does not incorporate formal user feedback.

The filtering categories in this prototype are populated merely for display purposes. The expertise of data structures experts, plus scholars in areas of diversity or sociology and the STEM workforce landscape would lend themselves to a more complete and succinctly categorized filtering mechanism. The career opportunities in STEM are vast and the people who fill STEM roles are even more diverse. The small sampling of filtering categories in this prototype suggest that future renditions of this project would require more strategic research and planning.

Lastly, the filtering functionality of this prototype, if it were to be brought to production, would be largely driven by tags. The scope of this project does not include a full discussion of the tagging structure.

Artifacts and discussion

Upon entering the mobile website, the user sees a basic home screen [Figure 7](#) featuring relevant imagery of a woman in a laboratory with only two options for the next action: start exploring the website by tapping the big yellow button, or view the menu by tapping the hamburger menu icon in the upper right corner. Per Hick's Law, limiting the options allows users to make navigation decisions more quickly [Lidwell et al., 2010](#) . Utilizing conventional visuals, such as the hamburger menu, and a rectangular button with shadowing around the edges makes the website more forgiving by "shorten[ing] the learning curve for users" as described by [Cheung 2017](#) . In line with the 80/20 rule and Hick's Law, blurring the backdrop while the hamburger menu is expanded [Figure 8](#) obscures information and options that are not relevant to the task at hand.



Figure 7. Home page display.

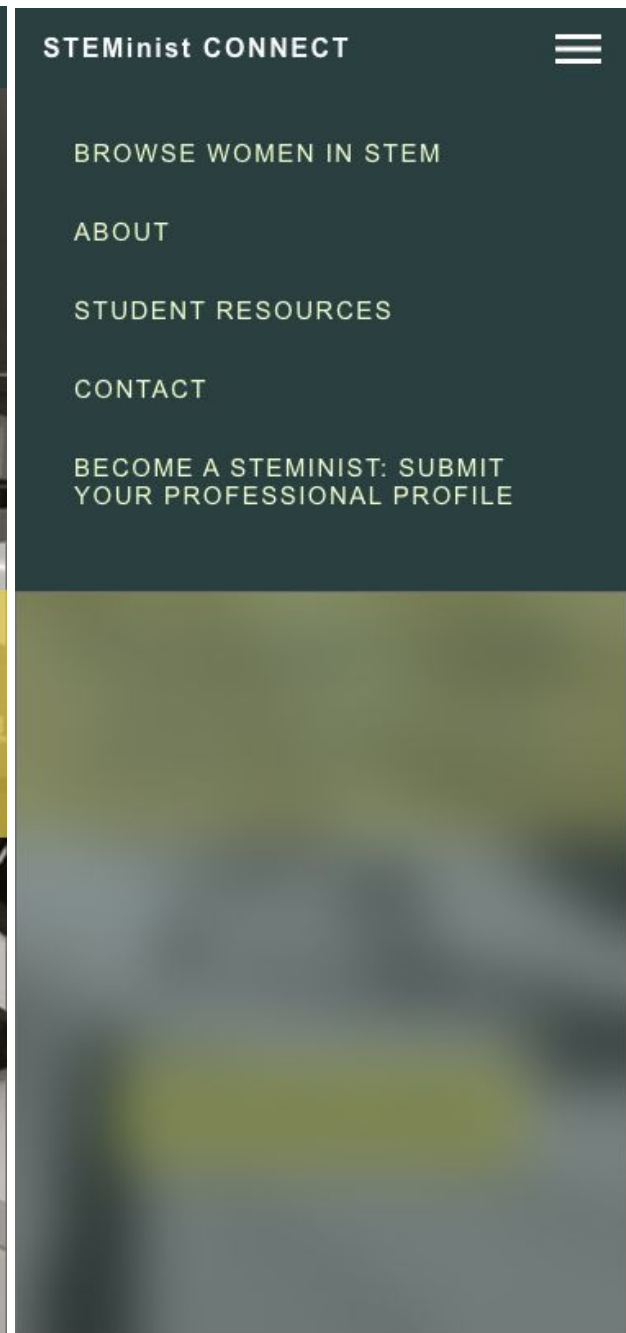


Figure 8. Main menu display when selecting hamburger menu in top right corner.

The default view of the repository tool Figure 9 , accessed by tapping the “Explore Now!” button on the home page Figure 7 or by selecting “Browse Women in STEM” from the hamburger menu at any time, features an unfiltered and randomized list of all influencers to encourage unbridled browsing and exploration. The color scheme consists of analogous colors, meaning the span of greens and yellows sit side by side on a 12-part color wheel Lidwell et al., 2010 . While adding a vertical scroll bar would visually indicate that the list extends beyond view Cheung, 2017 , I elected to reject the suggestion. For mobile technology, scrolling is a basic user behavior that is inherent to almost every application. For example, Instagram promotes a feed of content viewed by scrolling vertically without ever displaying a scroll bar.

Users may tap on social media icons from the list view to open the social media account in the respective social media app on their device if it is already installed. If the application is not already installed, selecting the social media icon will open up the influencer’s feed in a web browser. For most social media platforms, the user is encouraged to download the application when they attempt to view it in a web browser, but they may bypass the suggestion and view it in a web browser with limited functionality.

Alternatively, if the user wants to learn more about a specific influencer and see preview feeds of the associated social media accounts first, they may tap the influencer’s tile within the list view Figure 9 , and the profile view will appear in the forefront Figure 10 , blurring the details of the list view behind it. In the profile view, tabs indicate when multiple social media feeds can be previewed. Users can scroll through the last 10 posts in each embedded feed. Permitting users to preview the feeds minimizes the need to continually exit the website, unless, of course, they would like to take action and actively follow the influencer on social media. From the profile view, users can use the forward and backward arrows to flip through the expanded profiles in the order they appear in the list view. Tapping any element within the social media

feed previews user name, image, ... , ♥, etc. will prompt the respective application or web browser view of the application to open. Users may select the X in the upper left corner of the profile view to return to the list view.



Figure 9. Default exploration page with list view.

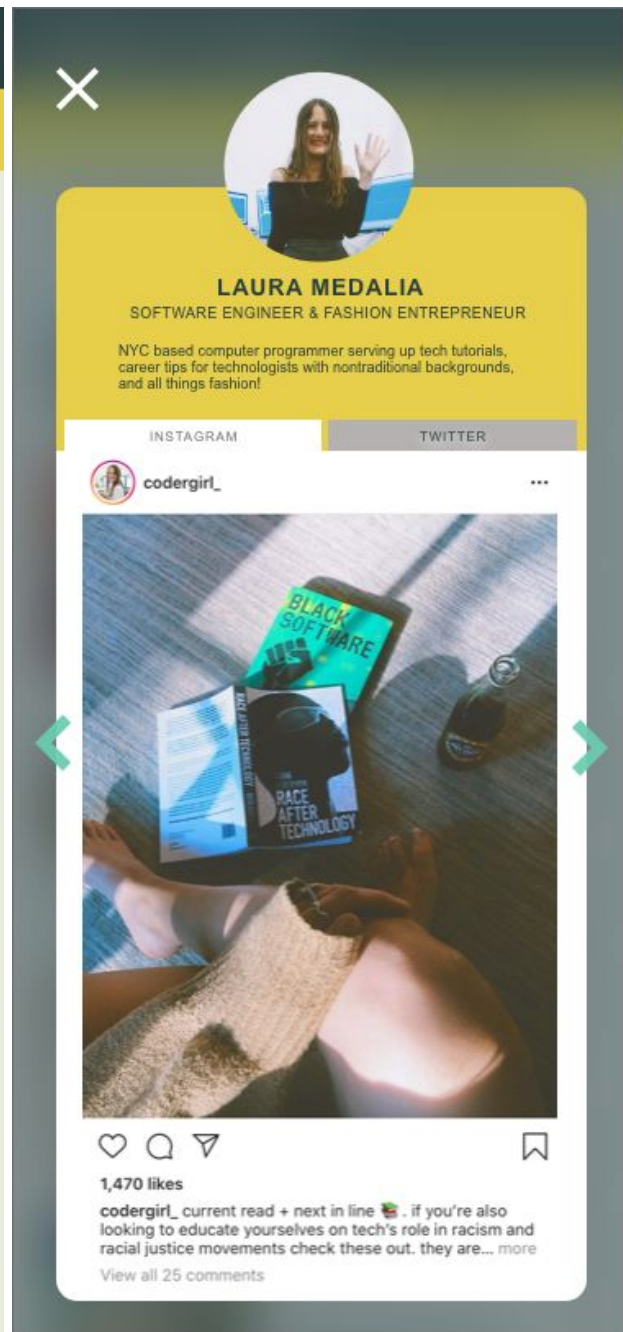


Figure 10. Pop up influencer profile display when the user selects an item from the list view.

While the default list view of influencers promotes random exploration and may encourage users to learn more about careers and people they might not normally be inclined to connect with, manipulating the filters offers greater customization. Because researchers have identified the importance of diverse representation of role models in STEM as a positive influence toward encouraging girls to develop confident “STEM identities” CAISE, 2018; Drury, Siy, Cheryan, 2011 , this mobile website encourages users to integrate their own filtering criteria, including self-descriptive criteria. While in the list view Figure 9 , selecting the filter icon in the upper right hand corner expands a menu of filtering categories. Each category can be expanded or contracted to reveal or hide additional criteria by tapping the +/- . Once filtering options have been selected from the criteria Figure 12 , the user can tap “Apply Filters” to generate a refined list view.

The filtration methods will differ depending on the filter category. For example, Education criteria such as the college or university at the influencer attended might take the form of a search bar with suggestions that appear as the user types, or as a multi step filter where the user first selects the state from a scroll wheel, and then a narrowed list of colleges and universities from a drop down list of institutions within that state. In other words, it would not be feasible to list every college and university in the United States in the form of unique check boxes, as there are more than 4,000 institutions within the United States Moody, 2019 . The sample filter criteria displayed here is neither complete, nor optimized for the data type.

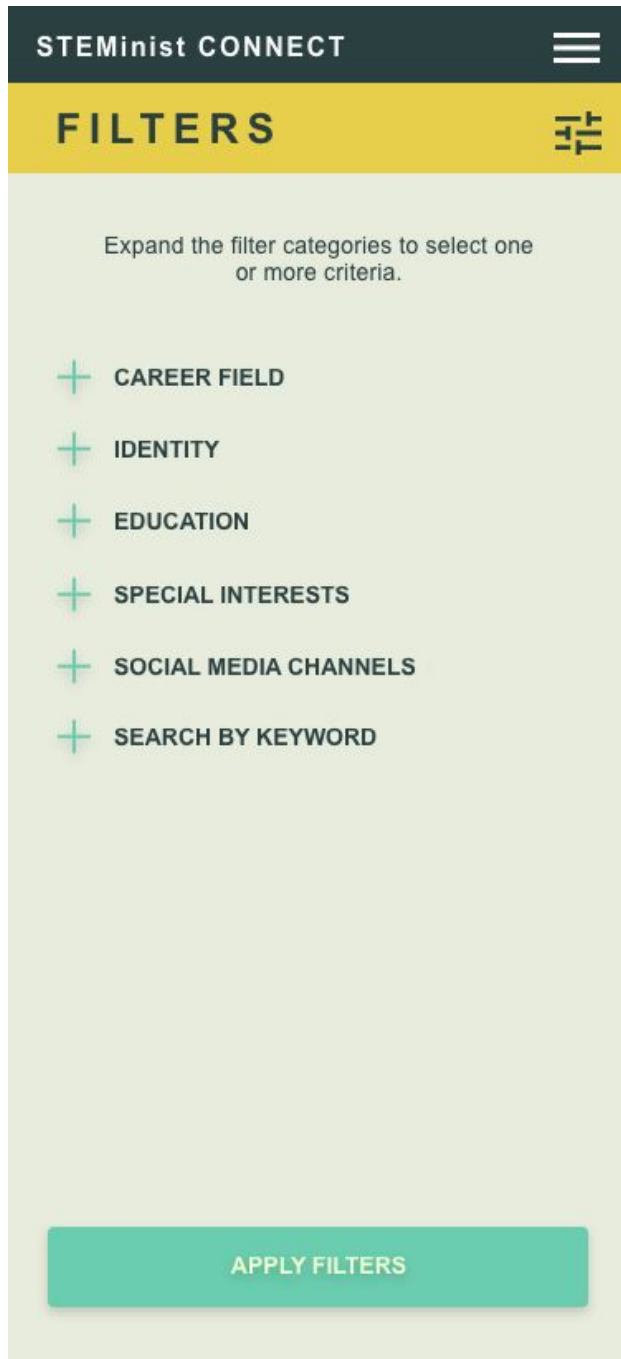


Figure 11. Filter category list displays when filter icon is selected.



Figure 12. Example of expanded filter categories, displayed and hidden by selecting + or - respectively.

Lastly, once the user has applied their custom filter selections, a list display of results appears Figure 13 . The redundancy of displaying the filters that have been applied as pill tags ensures that users understand the path of selections taken to arrive at their custom list display Cunha, 2017 . Per the design principle of forgiveness Lidwell et al., 2010 , users may remove one or more of the applied filters to expand their results, or select “Clear Filter” to easily start over. Selecting “Clear Filter” will return the user back to the default list view with a randomized list of influencers Figure 9 . Alternatively, the user may select the filter icon in the upper right corner to expand the filtering menu Figure 12 , see their selected criteria, and adjust their selections before re-applying the filter criteria. Integrating the redundancy of selections was a best practice that at first did not seem intuitive as I was designing the filtering concept, as I was making a conscientious effort to minimize “visual clutter.” However, reconsidering the literature on mechanisms that promote forgiveness, plus the industry best practices for UXD pushed me to rethink the decision and consider multiple possible scenarios of user activity that would warrant easy adjustments to the filtering selection without backtracking to the full filter menu.

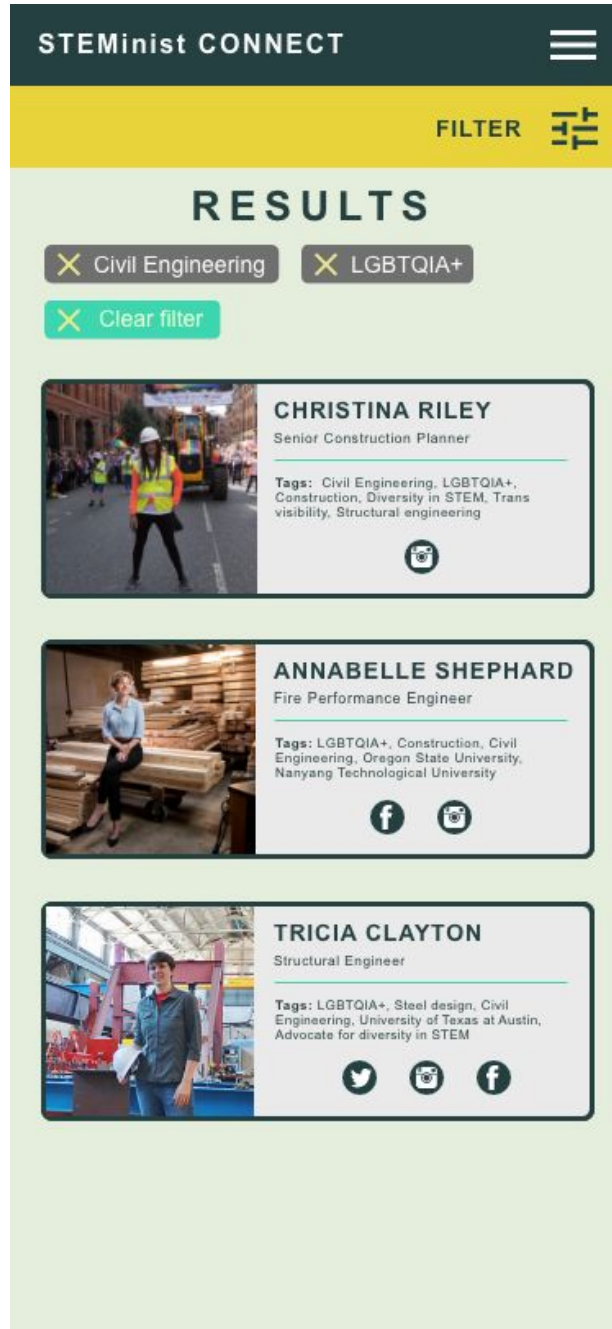


Figure 13. Sample filter results.

Considerations for future development

Formally assessing and analyzing the design would be an important step toward any future development of the repository tool. The process for evaluating the design could entail a combination of various research methods including the implementation of a software that tracks and analyzes user behavior, or direct feedback from test users in the form of surveys or focus groups Knowles, 2018 . User Experience Designers conduct user research “to gain a clear understanding of the underlying challenges, motivations, and behaviors of your users” in order to work through “observed user challenges, friction points, or gaps of understanding” Knowles, 2018 . Conceptually, I have based the very existence of this tool on research about a greater need in the STEM pipeline and technology use habits of the target demographic, but the audience itself is the only voice that can truly indicate whether the webpage and its design is useful, easy, or enjoyable to use.

For future development of the repository, methods of sourcing content for the repository could be considered in a more sophisticated manner. The collaboration of a professional with in-depth knowledge of data scraping could result in a mechanism that scrapes the web to source influencers for the repository. Additionally, the webpage would include a submission form where influencers could submit their own profiles, social media accounts, and requested information to be filtered and tagged appropriately. During the prototype phase, I added a menu item for professionals to submit their own information as a placeholder, but did not conceptualize as far as what this form would look like or how it would connect with the administrative functions of the tool on the back end. Alternatively, with more time, the product owner could execute individualized outreach to collect this information.

While the proposed mobile website serves as a potential solution to reach high school girls specifically, future development of the tool could adapt the design to reach a variety of

audiences of all genders who are underrepresented in STEM. Instead, if future research finds that segmenting the user population allows for a more targeted and effective approach, the design could be duplicated and customized to different audiences with branding that reflects the target audience.

Reflection

Creating this mobile website prototype was a truly enriching experience in connecting research from multiple disciplines to solve a problem. While literature on STEM diversity often points toward community outreach activities and classroom bound experiences as solutions to bridging diversity gaps, I encountered few instances where researchers considered the existing technological platforms, already embraced by their audiences, that have the potential to deliver continuous and authentic messaging. Perhaps the rapidly changing nature of digital and social media trends constantly leaves researchers a few steps behind.

The most challenging part of this project was learning to use Adobe XD for the first time, as there was a moderate learning curve with the basic functionality of the software. I am certain that there were many exciting features in Adobe XD that I did not even touch upon in this project. As someone with minimal technological knowledge of website design, I chose to create a prototype instead of a fully functioning website. However, with more time in the semester, I might have committed to learning some website basics to create a functioning tool with a sample of content. In my preliminary research, I found that displaying embedded social media feeds for some platforms requires the feed owner to provide a “key,” which was another reason I decided to pursue a prototype. With a more expansive timeline, I might have been able to connect with a multitude of influencers to ask their permission to display their feeds. This obstacle is something that could potentially be overcome if influencers were to submit their own information and consent.

Broadly speaking, working on this project reinforced the concept that good solutions do not always need to be newly invented ones. Instead of creating a new networking platform to address the poor visibility of female role models in STEM, my research on media usage by demographic proved that existing platforms already had robust and active membership, so the energy would be better spent connecting the audience to role models on a platform they are already familiar with, rather than encouraging the audience to sign up for a new network.

Conclusion

The technology usage habits of teenagers makes the choice of a mobile website, and better yet, one that leverages the integration of heavily utilized social media platforms, an ideal modality to introduce high school girls to female role models in STEM Guzman, 2016; Lenhart et al., 2015 . Integrating Universal Principles of Design into the structural, functional, and visual design of the mobile web page promotes user satisfaction and elongated use, resulting in repeat use and thus increased connections to role models. Additionally, incorporating opportunities for users to integrate their own preferences and identities into their experience by leveraging User Experience Design principles such as customization impresses the message that people of all identities and experiences can be successful in STEM careers. While there is much work to be done to improve diverse representation in STEM education and STEM professions, solutions of any type should take into consideration the needs and behaviors of their target audiences. Mobile technology may offer logical platforms for engagement, but thoughtful design based on research and user feedback will ultimately determine the initiative's success.

References

Allabarton, R. 2016, June 28 . Explaining UX design to your team. *UX Magazine*.

<https://uxmag.com/articles/explaining-ux-design-to-your-team>

American Association of University Women AAUW . 2020. The STEM gap: Women and girls in science, technology, engineering, and mathematics. *AAUW Research and Data*.

<https://www.aauw.org/resources/research/the-stem-gap/>

American Physical Society. 2017 . Bachelor's degrees earned by women, by major. *APS Physics: Education and Diversity*.

<https://www.aps.org/programs/education/statistics/womenmajors.cfm>

Anderson, M. Jiang, J. 2018, May 31 . Teens, Social Media Technology 2018. *Pew Research Center: Internet and Technology*.

<https://www.pewresearch.org/internet/2018/05/31/teens-social-media-technology-2018/>

Associated Press-NORC Center for Public Affairs Research 2016 . Issue brief: Instagram and Snapchat are most popular social networks for teens; Black teens are most active on social media, messaging apps. *AP-NORC*.

<http://apnorc.org/projects/Pages/HTML%20Reports/instagram-and-snapchat-are-most-popular-social-networks-for-teens.aspx>

Barratt, B. 2018, November 17 . The need for more women in STEM roles goes beyond simple diversity. *Forbes*.

<https://www.forbes.com/sites/biancabarratt/2018/11/17/the-need-for-more-women-in-stem-roles-goes-beyond-simple-diversity/#4a7cc42b45cb>

- Beede, D., Julia, T., Langdon, D., McKittrick, G., Khan, B., Doms, M. 2017, August . Women in STEM: A gender gap to innovation. *U.S. Department of Commerce: Economics and Statistics Administration*. <https://files.eric.ed.gov/fulltext/ED523766.pdf>
- Borchers, N. 2019 . Social media influencers in strategic communication. *International Journal of Strategic Communication* 13 4, 255-260,
<https://doi.org/10.1080/1553118X.2019.1634075>
- Bossart, J. Bharti, N. 2017, December . Women in engineering: insight into why some engineering departments have more success in recruiting and graduating women. *American Journal of Engineering Education* 8 2.
<https://files.eric.ed.gov/fulltext/EJ1162927.pdf>
- Cao, J. 2013 . How Hick's Law Applied to UX Design. *UXPin*.
<https://www.uxpin.com/studio/blog/applying-hicks-law-to-web-design-free-example-wireframes/>
- Center for the Advancement of Informal Science Education 2019 . The role of identity in STEM learning and science communication: Reflections on interviews from the field.
<https://www.informalscience.org/sites/default/files/CAISE%20Identity%20Overview.pdf>
- Coates, K., Ellison, A. 2014 . *Introduction to information design*. Retrieved from
<https://ebookcentral.proquest.com>
- Cunha, L. 2017 . How to craft a kickass filtering UX. *UX Collective*.
<https://uxdesign.cc/crafting-a-kickass-filtering-ux-beea1798d64b>
- Dasgupta, N. Stout, J. 2014 . Girls and women in science, technology, engineering, and mathematics: STEMing the tide and broadening participation in STEM careers. *Policy Insights from the Behavioral and Brain Sciences*, 1 1 , 21-29.
<https://journals.sagepub.com/doi/pdf/10.1177/2372732214549471>.

Drury, B., Siy, J., Cheryan, S. 2011 . When Do Female Role Models Benefit Women? The Importance of Differentiating Recruitment From Retention in STEM. *Psychological Inquiry* 22 4, 265–269. <https://doi.org/10.1080/1047840X.2011.620935>

Firdaus, T. 2013 . Responsive web design by example beginner's guide. Packt Publishing Limited.

Fitbit Community 2018 . Feature suggestions: Extend the 10 day period tracker [user posts in online forum]. *Fitbit Community*.
<https://community.fitbit.com/t5/Feature-Suggestions/Extend-the-10-day-period-tracker/idi-p/2722339#>

Gerolimos, M. 2009 . Tagging for libraries: A review of the effectiveness of tagging systems for library catalogs. *Journal of Library Metadata* 13 1, 36-58.

Google. 2012, November . Hyper connected tweens and twenty-somethings [infographic]. *Think with Google*.
<https://www.thinkwithgoogle.com/consumer-insights/the-media-habits-of-teens-and-young-adults/>

Guzman, A. 2016, April 7 .6 ways social media is changing the world. *World Economic Forum*.
<https://www.weforum.org/agenda/2016/04/6-ways-social-media-is-changing-the-world/>

Hong, L., Page, S. E. 2004 . Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proceedings of the National Academy of Sciences of the United States of America* 101 46, 16385–16389.
<https://doi.org/10.1073/pnas.0403723101>

Imafidon, A.M. 2018, October 22 . More women must be encouraged into STEM subjects- Not for diversity quotas but for the future of innovation. *HuffPost*.

https://www.huffingtonpost.co.uk/entry/stem-subjects-diversity_uk_5bcceaf7e4b055bc9481ee4a

Knowles, C. 2018 . 8 UX research methods to start using in web design. *Growth-Driven Design*.

<https://www.growthdrivendesign.com/blog/ux-research-for-web-design-8-methods>

Laja, P. 2019, April 17 . 8 web design principles that still work in 2020. *CXL Institute*.

<https://cxl.com/blog/universal-web-design-principles/>

Lenhart, A., Smith, A. Anderson, A. 2015, October 1 . Teens, technology, and romantic relationships: from flirting to breaking up, social media and mobile phones are woven into teens' romantic lives. *Pew Research Center*.

https://www.pewresearch.org/wp-content/uploads/sites/9/2015/10/pi_2015-10-01_teens-technology-romance_final.pdf#3

Lidwell, W., Holden, K., Butler, J. 2010 . *Universal Principles of Design*. Beverly, MA: Rockport Publishers, Inc.

Mailchimp 2020 . Getting started with tags. *Mailchimp*.

<https://mailchimp.com/help/getting-started-tags/>

Merriam-Webster. n.d. . Social media. In Merriam-Webster.com dictionary. Retrieved June 13, 2020, from <https://www.merriam-webster.com/dictionary/social%20media>

Moody, J. 2019, February 15 . A guide to the changing number of U.S. universities. *U.S. News World Report*.

<https://www.usnews.com/education/best-colleges/articles/2019-02-15/how-many-universities-are-in-the-us-and-why-that-number-is-changing>

National Alliance for Partnerships in Equity 2020 . Role models and mentors. *NAPE*

Resources. <https://napequity.org/resources/role-models/>

Noonan, R. 2017, November 13 . Women in STEM: 2017 update. *U.S. Department of Commerce: Economics and Statistics Administration.*

<https://www.commerce.gov/sites/default/files/migrated/reports/women-in-stem-2017-upd-ate.pdf>

Olapic. 2018 . The psychology of following.

<http://www.olapic.com/resources/consumer-research-psychology-following-whitepaper-s1cp/>

Pixlee n.d. . Social media influencer definition.

<https://www.pixlee.com/definitions/definition-social-media-influencer>

Robelen 2012 . STEM gender gap pronounced in U.S. *Education Week* 31 36, 8-9.

<https://www.edweek.org/ew/articles/2012/07/18/36stem.h31.html>

Sharp, H., Preece, J., Rogers, Y. 2019 . Interaction design: Beyond human-computer interaction 5th edition . Wiley.

Simpkins, S.D., Davis-Kean, P., Eccles, J. 2006 . Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology* 42 70-83.

Statista 2020, June 15 . Mobile share of organic search engine visits in the United States from 3rd quarter 2013 to 1st quarter 2020. *Statista.*

<https://www.statista.com/statistics/297137/mobile-share-of-us-organic-search-engine-visits/>

U.S. Web Design System ESWDS . 2020 . Design token: Using color.

<https://designsystem.digital.gov/design-tokens/color/overview/#color-and-accessibility>

Walker, L. 2020 . How to use Instagram on a PC or Mac. *Lifewire.*

<https://www.lifewire.com/how-to-use-instagram-on-a-computer-pc-or-mac-2654648>

Web Design Museum. 2020 . Web design history timeline: 1990 to present. *Web Design*

Museum. <https://www.webdesignmuseum.org/web-design-history/timeline-2009-2017>

Werner, S. Tankard, J. 1997 . *Communication theories: Origins, methods, and uses in the mass media*. Boston, MA: Addison Wesley Longman.

West Elm. 2020 . West Elm home decor customer shopping interface.

https://www.westelm.com/shop/lighting/mid-century-lighting-collection/?cm_type_gnav

Williams, J. 2015, March 24 . The 5 biases pushing women out of STEM. *Harvard Business*

Review. <https://hbr.org/2015/03/the-5-biases-pushing-women-out-of-stem>

World Economic Forum 2018 . In depth: Is there a formula for innovation? *The Global*

Competitiveness Report 2018.

<https://reports.weforum.org/global-competitiveness-report-2018/in-depth-is-there-a-formula-for-innovation/>