

A Tangible Solution to Closing the Gender Gap in Engineering

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ABSTRACT

Despite decades of effort to improve the gender disparity in engineering, women represent only 13% of engineers today, as stereotypes and unsupportive environments turn them away from the progressing field. By interweaving and building upon existing projects that have worked to close the gender gap in engineering, we plan to create a curriculum-based website to educate women and heighten their interest in engineering. Through games, career quizzes, research, communication forums, and professional accounts in this field, our project seeks to expand the number of female engineers in the workforce.

Background

Living in the 21st century, the adoption of new technologies is common, and the progression of technology is rapid. Amid the swift changes, engineering proves to run first in line. According to data collected by the Bureau of Labor Statistics in 2019, employment in engineering occupations is expected to grow 6% from 2020 to 2030. Currently, there are approximately 2 million engineers from data collected by the US workforce in 2018. However, out of the 2 million, only 13% are women. Despite the rapid technological innovations, gender inequality in engineering careers remains significant. While women are paid a median annual salary of \$75,000 as engineers, their male counterparts are making \$89,000. This large gap deters young females from considering becoming an engineer.

The decline of young women pursuing engineering can be clearly seen in recent statistics collected from high school environments. For example, statistics collected by the CollegeBoard show that only 19% of AP Computer Science test takers were women. The small percentage vividly paints an image that resources to explore engineering are less accessible for young women. Corroborated with experiences from first-hand interviews, an informal survey was conducted in San Francisco amongst rising high school seniors. A high schooler from San Francisco stated that in her AP Computer Science A class, there are only five women out of 35 total students. The small number puts the issue into context. It can be accurately inferred that if young women take little interest in engineering in high school, they are less likely to pursue it as a career in college.

According to the study conducted in 2009 on *Ambient Belonging: How Stereotypical Cues Impact Gender Participation in Computer Science* [5], results indicate that stereotypical environments can negatively impact women's interest in computer science from 0.5 to -0.5 (-1 being no interest and 1 being complete interest) compared to non-stereotypical environments. This furthers the idea that in order to build a sense of belonging, a positive environment must be fostered for women in order to build their confidence and encourage them toward an engineering career.

When female software engineers, mechanical engineers, and electrical engineers only make up a small part of the field (18%^[2], 14%^[3], 10%^[4] respectively), it discourages young women from taking a stance and interest in engineering. A sense of a supportive community and belonging is important to provide young women with a successful path to pursuing an engineering career.

There have been countless efforts sought to close the gender gap by providing free coding boot camps, but many lack in the way information is presented, for example, the youth-led organization *GurlsWired* leads a free virtual coding boot camp in the summer. While this is a great resource for young women to start exploring computer science, it lacks a formidable presentation. The flyer does not specify which age group or experience the camp is best fit for and lacks credible information such as who will be leading the camps and what coding experience they have. This can potentially lead to a smaller number of attendees and shave away any potentially interested audiences. To better improve this resource, information can be specified. With our herplusengineer.org, we seek to serve as a bridge for young women by offering accessible engineering resources that are tailored for beginners exploring the field.

Methods

After considering many forms of outreach, we decided on creating a website called herplusengineer.org to share engineering resources geared towards young women. As digital media has become more accessible and understandable thanks to the ubiquity of consumer electronics, an eye-catching online platform would be the most effective tool to spark a passion for engineering in as many girls as possible.

The website begins by grabbing the attention of visitors through a picture-based career quiz. The results of the quiz will forward the visitor to the matching career page that teaches everything about what that job does, what skills and education were needed, and examples of popular companies that hire those kinds of engineers. This method personalizes the learning experience for the user, keeping them constantly engaged and motivated to learn about what kind of engineering is best suited for them.

After learning a bit about what different engineering fields are like, the user can move on to listening to the personal experiences of female role models in engineering. We believe this way of connecting with someone who has a similar background as a woman will further motivate girls into following in their footsteps and becoming engineers themselves. The women we chose to interview were not particularly famous, but that is because we decided that having these stories come from people who are the most relatable to the average visitor was most important.

Finally, the resource pages offer plentiful videos and articles relevant to the engineering field of interest. These include vlogs with an insider view of what it is like to be an engineer for a day, introductory lessons on critical technical skills, fascinating novel inventions, and more. These videos and articles are all media that somebody in the field would find interesting, so we hope they can induce the same kind of curiosity in a girl who sees it with fresh eyes.

Ultimately, each section of the website has a unique way of reaching out to the visitor about the opportunities available as a woman in the STEM field. Whether with a personalized quiz, a woman's true story, or a plethora of eye-catching content, our website will surely assist in the movement for closing the gender gap in engineering.

Results

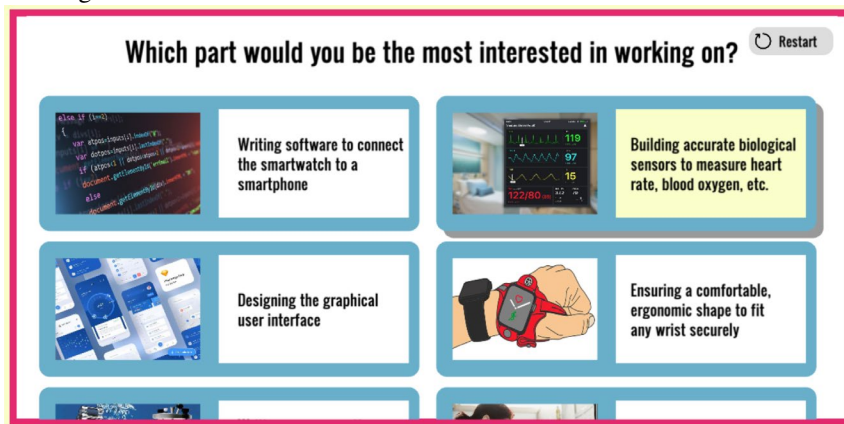
The Career Quiz

The career quiz is a multi-step quiz that women can use to try and find a specific field in engineering that might work well with their skills and interests.

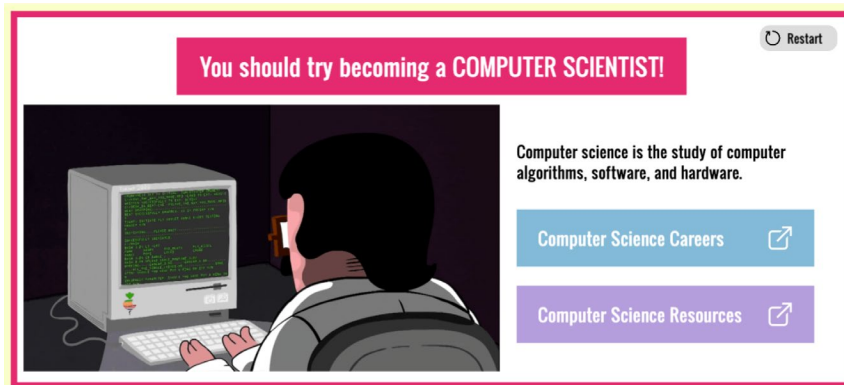
1. The quiz first asks the user to choose what object appeals to them to build from ten different options.



2. After the user chooses an option, the quiz asks them a specific question about what part of the object they would be most interested in working on.



3. Based on their answers, the user receives a career recommendation that best suits them, along with links to other parts of our website and external resources that introduce that career.



The Career Resources Pages

The career resources pages are a collection of resources for the fields of Computer Science, Mechanical Engineering, and Electrical Engineering.

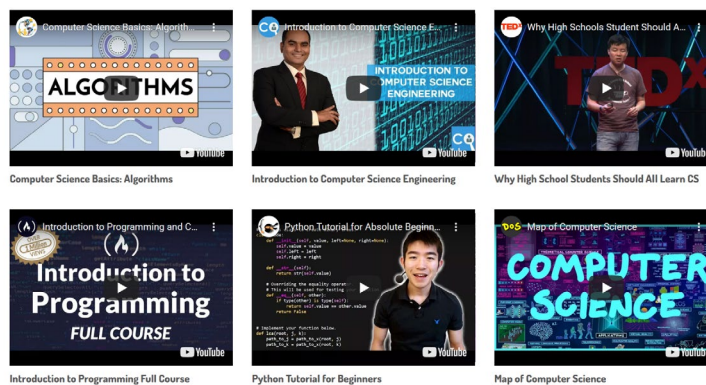
1. First, each page features numerous day-in-the-life videos of career professionals working in that field and students in university majoring in engineering. The goal of these videos is to show aspiring female engineers what life would be like if they continued to pursue a career in engineering and motivate them.

Computer Science Resources

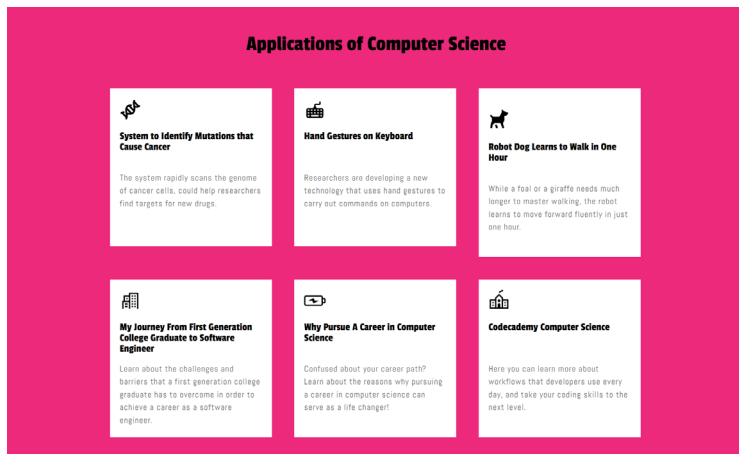


2. In addition, we provide several introductory videos for the engineering fields and tutorials on basic skills and topics. These videos provide women with a more comprehensive understanding of what these fields entail.

INFORMATIONAL VIDEOS & TUTORIALS

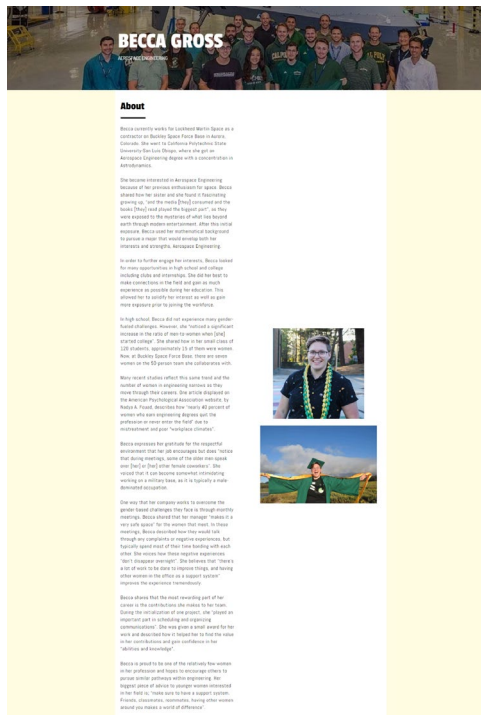


3. Furthermore, these pages also feature articles that cover the real-world applications of their respective engineering fields. For example, the articles for the computer science resource page include projects that identify mutations in DNA that cause cancer and a robotic dog that uses machine learning.



The Meet the Professionals Page

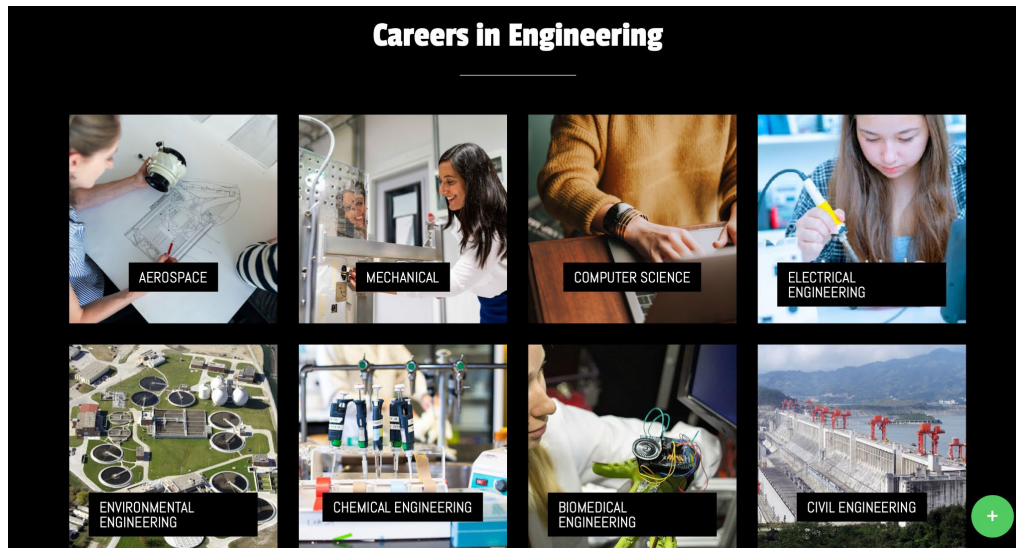
The meet the professionals pages are biographies of women who work in engineering. The biographies detail their educational pathway, gender-fueled barriers they have faced and how they have overcome them, and advice they have for aspiring female engineers. These individuals will serve as role models for young women who are curious and/or anxious about their engineering pursuits.



Our hope is that these biographies will help relay advice from women working in engineering fields that may help motivate and encourage students.

The Careers Pages

Last but not least is the careers page. Users of the website can access information on ten different careers in engineering. They are given general information about each career including a general description, education requirements, necessary skills, and companies that hire these kinds of engineers.



The purpose of this page is to help inform users of the website of the different careers in engineering. This may help them narrow down a specific career path they want to follow.



WHAT IS BIOMEDICAL ENGINEERING?

Biomedical Engineers design equipment and devices that aid in medical treatment. These innovations often include artificial organs, replacements for body parts, machinery for diagnosis, machinery for treatment, implantable medical devices, and other equipment that allow medical professionals to care for their patients. In addition to the innovative aspect of their jobs, Biomedical Engineers often play a large role in the installation, calibration,

Take a look at the "Careers resources page" above for an example. This photo shows our description of biomedical engineering.

Skills
Analytical skills, creativity/ eye for design, communicative skills, empathy, problem-solving skills

Education
Bachelor's degree in Bioengineering, Biomedical Engineering, or a related engineering field. However, some positions require a graduate degree.

Specialties
Global health, Biomedical Cell & Tissue Microdevices, Biophotonics, Nanomedicine, Medical Imaging, Regenerative Medicine, Biomedical Devices, Assistive Devices

Above are the skills, education requirements, and specialties for biomedical engineers.

EMPLOYERS



Lastly, we have examples of major employers of biomedical engineers.

Discussion

After extensive research on the gender gap in engineering, our group was able to create a website that provides resources, support, encouragement, and information to young women interested in pursuing a career in engineering. Some of our research and conversations with women in the field displayed how one necessity of upholding interest in engineering is having other female role models in the field, as well as information that allows these young girls to picture themselves in an engineering career. This research greatly contributed to our website. Because of these findings, we created the Meet the Professionals and Careers pages. Many more pages were added to further address these necessities.

We worked to provide a variety of resources including words from women across multiple fields of engineering, a long list of career examples and information, articles, vlogs, introductory videos, and research on the gender gap in engineering. We were able to create a quiz so that women may narrow their interests in the field and pursue something they find fascinating or familiar.

We believe that the large variety of resources available through our website will resonate with young girls interested in engineering. By fostering this interest, they will be encouraged to pursue engineering. Each time a person is able to further explore her interest on our website and choose a career path related to this interest, we will be successful in reducing the gender disparity in the fields of engineering. Our website has the potential to reach many young women, and gradually close the gender gap in engineering.

Future Directions

Looking forward, we hope to improve the website by refining its current features, developing new features, and increasing its reach, in order to encourage interest in engineering in young women even more effectively.

One feature that we hope to expand is our resource pages. We currently have resource pages for mechanical engineering, electrical engineering, and computer science that include vlogs of individuals working in the industry, introductory/educational videos, and articles that are relevant to each engineering career.

In the future, we hope to expand on this feature and provide resources for a wider range of engineering fields, including aerospace, environmental, chemical, biomedical, civil, materials, and industrial engineering. Of course, there is a possibility for more expansion by providing resources for more obscure engineering careers, but we believe that these more mainstream careers will be a great start to allowing young women to discover the numerous engineering disciplines that they may choose to pursue.

One feature that our group has yet to develop is a communication forum on our website. Throughout our interviews with professionals, a common piece of advice that they shared was the necessity of a support system involving other women and role models. It would be beneficial to provide a platform for women to establish connections with those who share similar interests and gain advice from others further along in their careers. This forum would be open to young girls interested in engineering, as well as professionals, college students, and other women in engineering who would like to share their own experiences and knowledge with others. This feature would be monitored so that women may pursue their interests freely and safely. We hope that a chat forum will allow women to connect with each other, share achievements/innovations, and ask questions that will allow them to further explore this field.

In addition to improving features, efforts such as community engagement and partnerships would be beneficial in reaching aspiring female engineers. One feasible option would be to form partnerships with middle and high schools. Many of our studies have shown that the gender gap in engineering can be traced back as early as high school, therefore sharing our website with students would be beneficial and can encourage access by sharing our platform with school districts and partnering with them to provide our website as a resource for those exploring passions in engineering. With this partnership, teachers will be able to encourage students to explore the website and further their interests. Because the resource will have come from a teacher or faculty member that hopes to nurture the student's interest in engineering, they will already be exposed to the support our group hopes to reflect on this website.

Outside of educational expansion, there are many organizations that hope to raise the number of females in STEM fields. Some of these organizations include The Association for Women in Science, The Global Alliance for Diversifying the Science and Engineering Workforce, The Society of Women Engineers, and Women in Engineering Program & Advocates Network (WEPAN). These organizations all hope to make an impact similar to the vision we had for our website. They provide extensive amounts of resources, information, and support for women in engineering fields. Because of our shared visions, these organizations may also hold opportunities for our website to reach a larger audience. Reaching out to these organizations and working with them will allow us to expand our influence.

There are endless future directions for our website, and we hope that our continued efforts will inspire and foster countless women to become accomplished engineers.

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