Takeaways from an Internship; How to Expand Upon Learned Skills to Full-Time Employment

(Technical Paper)

Investigating the Gender Gap and How to Achieve Greater Gender Equality

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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In this modern age of technology, computers have become ubiquitous within society. As a result, computer science and fields alike have grown in popularity over the last couple of decades. However, despite this popularity, there exists an unmet demand for female computer scientists and an overall underrepresentation of females in these fields of study (Teague, 2002). In a collection of data from 2021 by the National Center for Education Statistics, in the graduating year of 2018 to 2019, females only accounted for 21% of the computer science degree recipients. Compared to the graduating year of 1985 to 1986, that same statistic was 36% ("Changing the curve," 2021). In order to revert the trajectory of this statistic it is imperative that a purposeful approach is taken to close the gender gap that is present within computer science professions.

Given the presence of technologies and the growing demand for computer science professions and the ability to code, it is important to analyze the key actors in the underrepresentation of female computer scientists and pinpoint a specific approach to achieve greater gender equality. The state-of-the-art technical report and my tightly coupled STS research both intend to investigate the presence of women in computing professions and to determine if and how companies contribute to this marginalized group. For the technical report, I will detail my experience interning at a service industry-based company, whose goal is to provide a low-code platform for all. The paired STS research focuses on detailing the issue of underrepresented women in computing and if companies that compute for the social good can be a possible solution to changing the gender stereotypes that exist within these computing fields. Through an adaptation of the Social Construction of Technology (SCOT) theory, a visualization of the issue and a proposed solution will be presented. Along with that, I will investigate if there

exist other relations to the gender role shifts, whether positive or negative, that women in computing have faced.

TAKEAWAYS FROM AN INTERNSHIP; HOW TO EXPAND UPON LEARNED SKILLS TO FULL-TIME EMPLOYMENT

Over a 10-week-long internship, I satisfied the role of a software developer in a large service-industry-based company. The primary goal of this company was to promote a low-code development environment for users. Users can consist of individuals, groups, or companies. The goal is to provide a versatile and diverse application, in terms of who the intended user would be and its functional capabilities. A low-code platform is the idea that creators can develop software and applications with little to no coding knowledge or application. It removes the need for traditional coding and creates a faster and easier experience for any user to create software or application from scratch.

The purpose of providing such a product is to make software development more accessible to general users and to expand the capabilities of many companies. In our modern age of technology, the Internet and computers, both software and hardware are so involved in everyday life, and the ability to build products incorporating those aspects of technology is highly advantageous. Therefore, removing a time-consuming software development step and providing the user with the building blocks to do so significantly advances efficiency for many users and groups.

My internship focused on advancing a feature that allowed users to create data tables from scratch. My work included user experience changes, feature enhancements, and error handling. Data tables are the building blocks of a database and act as a data object containing all the relevant data needed within that specific database platform. Each column within a data table is an attribute with each row being a data entry satisfying those different attributes.

The main problem being addressed prior to the development of this feature was the trouble users faced associated with creating a data table in a third-party database platform and then manually linking that specific data table to verify and then publish within the company's low-code platform. The general process to do so is referenced in Figure 1. The primary issues associated with this include the third-party database platform not being supported, inconsistencies with the data table's format between both platforms, the potential for differing data table formats, unforeseen errors, and/or unforeseen inconsistencies. Furthermore, this overarching problem does not fit within the scope of a low-code environment.

Figure 1: Original Data Table Creation Process. Visual of the progression of steps that are required to develop a data table from a third-party database platform. (Gould, 2022)

As shown in Figure 2, the low-code-based approach minimizes the steps in the process of publishing a data table within the platform, allowing users to create a verifiable data table

Figure 2: Low-Code Based Process. Visual of the progression of steps that are required to develop a data table within the low-code platform. (Gould, 2022)

from start to finish within the company's platform. As an intern, my purpose was to enhance that feature for the user and to make the overall user experience cleaner and more straightforward to understand. A difficulty arising from creating a low-code platform from the knowledge level of a software developer is interpreting how a user with limited to no coding background can navigate the platform and understand any result errors.

A few specific implementations that I developed, such as integrating tooltips and adding error-handling dialogues, elevated the user experience and helped users with any sources of confusion. Additionally, my other work on the functionality of this feature allowed for a greater ability to create relationships and make connections between different data tables. Prior to the feature, creating a many-to-one relationship between different tables took substantially longer, but now the user can do so instantaneously by clicking a single button. The overall goal of this feature was to minimize the brunt of the work of creating a data table and ensuring compatibility between third-party and the low-code platform. From the work completed during my internship, the user experience and the company's low-code product have both been amplified.

Based on my experiences during this internship, I have gained both advanced technical and social skills that can be transitioned and adopted to future full-time employment. Furthermore, understanding my own appreciation for the fair representation of different social and professional groups within the company's intern problem is another important tool that I can apply to future jobs when assessing the positives and negatives of that company. Being a female computer science major in a male-dominated field, it is important to assess the social diversity within the company in order to reach a level of comfort with my own representation.

INVESTIGATING THE GENDER GAP AND HOW TO ACHIEVE GREATER GENDER EQUALITY

In the field of computing, there is a substantial disproportion between the presence of women and men. In a survey conducted by the Economics and Statistics Administration in 2009, women constituted 24% of science, technology, engineering and math (STEM) jobs compared to the overall 48% they represented for all professions. In the same study, it was found that a 14% gender wage gap exists, in addition to the already hefty gender gap. (Beede et. al, 2011). Overall,

this gender inequality in these fields is a prominent issue that needs to be identified and addressed to achieve any sense of fair representation.

Despite the demand for computing jobs, there is not a dramatic increase in the representation of females with no clear indication why. Factors contributing to this gender inequality have been investigated, with one such reason attributing gender stereotypes, particularly improper stereotypes emphasized in media (Mitchell & McKinnon, 2018). A leading obstacle for female scientists to overcome is the existing stereotypical gender roles established in the early twentieth century. The dissemination of gendered representations of these professions in the media discourages young females from pursuing such careers (Vitores & Gil-Juárez, 2016). Through a more purposeful representation of female scientists in the media, there can be a shift in the idea of females in this profession from being atypical to more widely accepted. Beyond career stereotypes, the misperceptions that have risen about the essence of computing as a consequence of it being male-dominated need to also experience a change in ideology to bring about fair representation (Teague, 2002).

This idea of unfair representation, illustrated in Figure 3, illustrates the current understanding of how the various social groups are being represented as engineers as an adaptation of the SCOT theory. To break down this model, the boundary of fair representation, in which male engineers currently stand, is defined by society and the perceived societal
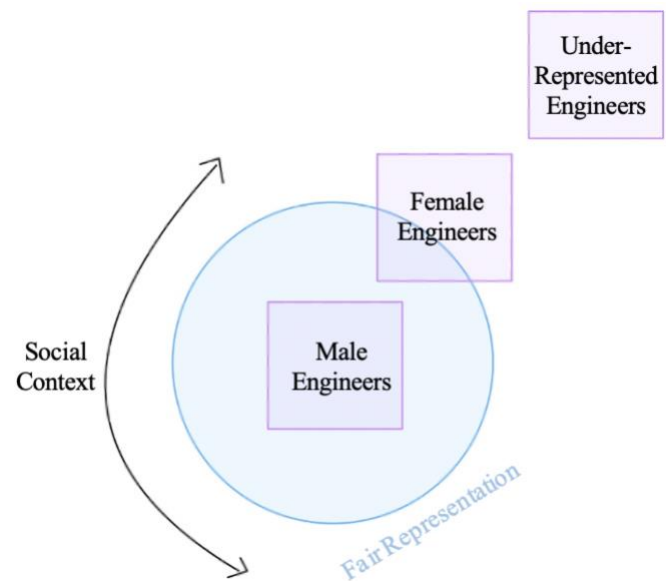
Figure 3: Computing workforce model. The 3 social groups are located in approximation to a boundary of fair representation that is shaped by the social context for those engineers (Adapted by Gould (2022) from Carlson, 2009)

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roles of those identified social groups. As such, the social context surrounds this model and is the pivotal determiner of how these different engineers can enter within the boundary. While female engineers do have some representation, indicated by their location on the cusp of the boundary, the other under-represented engineers are far from equal representation which is reflected by their furthest location in the model. This assertion concerning those who are under-represented is supported by a study by the Women and Information Technology Organization that identified that the computing workforce is constituted of "3 percent Black women, 2 percent Hispanic women and 7 percent Asian women" ("Changing the curve," 2021, para. 16).

To build upon this model and the one-defined possibility for the underrepresentation of females, the objective behind this STS research will be to investigate the other key factors that influence the shift in female presence in the computing workforce and to solidify a clear approach to how to achieve greater gender equality. Through a tangible process, it can be possible to reach a greater level of equalization. The primary solution I propose would be to set this standard starting with the employers. If companies began to strongly encourage female computer scientists and coders, they have the ability to set the precedence for what fair representation should look like.

This proposed solution is represented in Figure 4. Expanding upon the original model shown in Figure 3, a transition is illustrated for the social groups outside or on the cusp of the
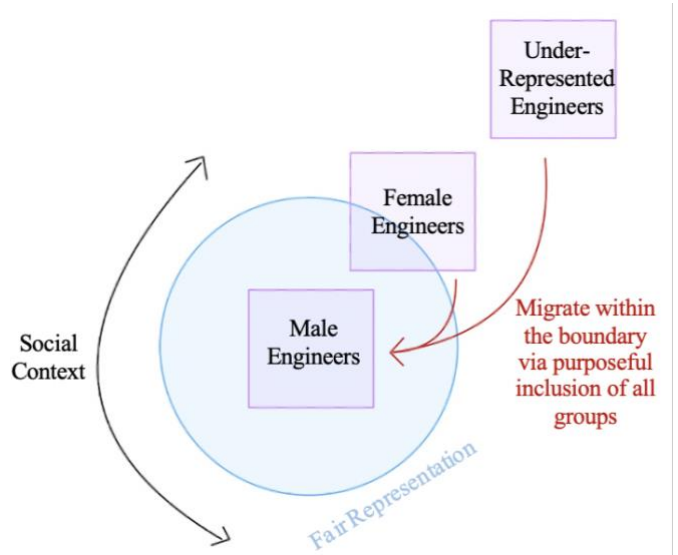

Figure 4: Computing workforce solution model. An approach to achieve migration within the boundary of fair representation is proposed (Adapted by Gould (2022) from Carlson, 2009).

boundary of fair representation to belong within those bound. The specific approach to do so is asserted that purposeful inclusion needs to happen to achieve that migration. This purposeful inclusion can be implemented by media, employers, peers, and/or society as a whole. Overall, an effort needs to be made by multiple parties to achieve positive shifts in societal role stereotypes.

Khan & Luxton-Reilly (2016) defined a similar solution to closing the gender gap by asserting that "integration of real-world relevance to computing is a means to challenge the traditional negative stereotypes and widen the appeal of Computer Science to under-represented audiences" (p. 4). More specifically, companies can set the pace for closing the gender gap and actively shifting the gender role stereotypes. Through marketing products in the computing field to a diverse population of users, it can help to improve perceptions about the nature of computing, inherently altering the stereotypes that are a result of those previous misperceptions. Dedicated efforts to include all social groups is pertinent in order to have fair representation for all.

As an outcome of this research, it encourages female engineers who are reading to maintain a positive outlook for their career aspirations and remain hopeful for their future representation within the professional workforce. Aside from female engineers, general readers gain a greater understanding for the underrepresentation that is present today and use this research as a tool to shift any of their own believed stereotypes about female scientists. Through the acknowledgement of the issue and research to support the problem and a solution, society can come one step closer to closing the gender gap that exists within computer science and fields alike.

COMPANIES AND THEIR ROLE IN ACHIEVING GENDER EQUALITY IN THE COMPUTING WORKFORCE

For a technological product to be computed for the good of society and marketed to all users, it is imperative that the group designing that product is well represented and diverse.

Essentially, the marketable goals within a company should be a reflection of their internal morals. Through the purposeful inclusion of all social groups and a greater emphasis on employing individuals from diverse backgrounds, companies can set the standard for fair representation of social groups within the computing workforce. The technical report serves as an example of that notion. The company behind the internship promotes a computing platform product to all social groups; thus, mitigating the existing stigma that computer science is a field intended for primarily males. Coupled with that, the STS research will aim to identify the underrepresentation of females and the gendered misrepresentations that exist within the field of computing.

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