

**An Exploration of a Historically
Marginalized Student's Experience with
Portfolios**

ME96: Senior Thesis

by

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Abstract

In recent years, more engineering education researchers have observed the potential of portfolio integration in engineering courses. Such a course was offered at a small predominately White institution in the northeast in the spring of 2021. I enrolled that semester. Portfolios were introduced as a virtual collection of any projects or information students wanted to include. Though no limitations were set in place, I found myself having to negotiate between my existing identities and the engineering identity I was beginning to develop. Ultimately, I took on a process known as self-authorship, which will be one of the focuses of this study. In this paper, I will explore the elements of my experience in engineering that surfaced during the portfolio-creation process and, in turn, influenced the portfolio choices I made.

This thesis will engage with methods grounded in autoethnography. By transitioning from research participant to co-researcher, I will be able to focus on my lived experiences rather than a narrative founded simply on observations. Racially minoritized students in engineering (Black, Indigenous, and Latine), gender minorities, and first-generation/low-income (FGLI) students experience college in a way that is not possible to fully analyze without the knowledge of lived experiences. Rather than attributing an experience to an isolated identity (i.e., race or gender), this thesis will detail experiences through an intersectional lens.

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1. Introduction

1.1 Background

According to the National Science Foundation (NSF), Black, Hispanic, and Native American students in STEM increased from 18% to 24% and the number of women increased by 31% between 2011-2021 (NSF, 2023). Despite the diversification of the field, not many curricular adjustments have occurred to reflect the needs of the students. Curriculum provides skills, knowledge, and values that support students in transitioning from engineering student to engineering professional. As engineering students begin their undergraduate journey, they must begin developing a professional identity. To do so, they must negotiate between societal and institutional expectations related to their profession (Eliot & Turns, 2011). However, existing data indicate that engineering remains a White-male dominated field (Riley, 2008; NSF, 2023). Thus, educators must carefully incorporate assignments that give historically marginalized students the opportunity to develop a professional identity. One of these methods, and one this study will explore, is a portfolio (American Association of Colleges & Universities, 2022)

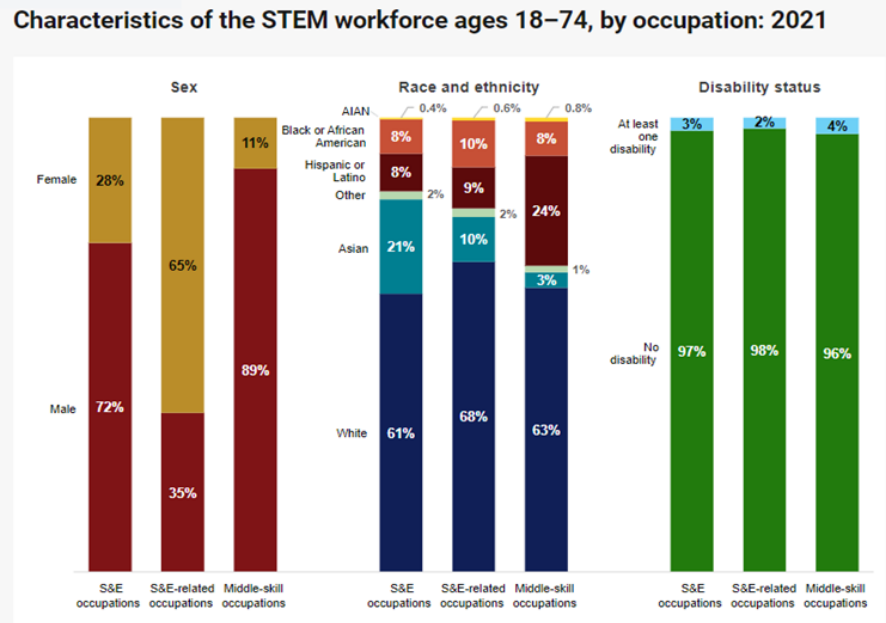


Figure 1: NSF bar graph of the characteristics of STEM workforce in 2021 (NSF, 2023).

Existing research indicates that portfolios can support students in two different ways: through an identity perspective and through a disciplinary knowledge perspective (Kilgore et al, 2013; Eliot & Turns, 2011). Self-authorship, which helps students understand their engineering identity, is executed from an identity perspective. Disciplinary knowledge perspectives, on the other hand, help students see the value in their past learning experiences. Alarming, none of the literature on portfolios mentions the role race, ethnicity, gender, socioeconomic status, or disability take part in the process of self-authorship. For engineering education literature, in general, existing literature isolates the experiences of a student to a single identity. Further, the proportion of engineering education research focused on the experiences of students with intersecting marginalized identities does not match the proportion of those students in STEM. Ong (2020) found that from 1999 to 2015, there were only 65 total empirical studies that analyzed the experiences of WoC in undergraduate engineering. This conclusion became clear as I looked for literature on the experiences of marginalized students when creating a portfolio. It was common

to read literature in which a student is categorized by a single identity (i.e., race or gender), which ignores the impact other identities (i.e., socioeconomic status, ability) have on the success or failure of portfolio methods.

The purpose of this thesis is to describe the events and outcomes of the portfolio development process in which I realized that I did not align with the disciplinary values of engineering.

Though I believe that portfolios have the “... *ability to help students like myself realize that it’s not that we don’t fit the description of engineering, it is that engineering doesn’t include us,*” this will not be the conclusion for all students. Intersecting marginalized identities can lead to differing experiences when creating a portfolio. Thus, my analysis of the portfolio development process will be informed by the following six key sociocultural concepts, which I summarize in the literature review section (Asset- Based Approaches, Cognitive Dissonance, Imposter Syndrome, and Intersectionality) and the theoretical framework section (Disciplinary Values and Self- Authorship).

1.2 Literature Review

The following paragraphs are important pieces of contextual information that will be necessary for understanding the conclusion of this thesis:

1.2.1 Asset-Based Approaches: Cultural Wealth and Funds of Knowledge

As previously mentioned, engineering education literature discussing the experiences of Students of Color (SoC) is limited. In this section, I will use examples from engineering education

literature that focus on one race or ethnicity and discuss the experiences of SoC as a group. To address the “opportunity gap” (Johnson- Ahorlu, 2012) between Students of Color (SoC) and White students, many researchers have taken on a deficit-based approach in which the students, rather than institutional barriers, are blamed. While deficit-based models discuss the importance of mitigating these barriers, they often lead to efforts that encourage students to adopt the behaviors and norms of existing academic institutions that are designed for privileged students (Smith and Lucena, 2016). As a result, the knowledge deemed valuable continues to favor White, wealthy, and male students and produces a framework that cannot embody the academic success of Students of Color (Yosso, 2005; Samuelson & Litzler, 2016). Two terms have emerged in education literature to challenge the deficit-based approach and transition to asset-based approaches. The first, Community Cultural Wealth (CCW), was developed to challenge traditional interpretations of cultural capital. Yosso (2005) based the concept of CCW on Critical Race Theory (CRT), thus shifting away from racialized assumptions that Communities of Color are to blame for “poor academic performance.” CCW says that there is capital, also referred to as value, in the knowledge and experiences that live within marginalized communities. Smith (2016) argues that deficit-based studies minimize the institutional barriers Black students face and lead to misconceptions about the ability of Black families to support STEM learners. Asset-based approaches, on the contrary, uplift Black knowledge and are key to understanding how to support Black engineers. In parallel, an asset-based approach would imply that the experiences of Latine students provide knowledge that is related to STEM and when acknowledged, can promote their identity in STEM (Verdin et al, 2021).

A second asset-based approach is funds of knowledge in which the knowledge and skills that have been historically and socially collected are valued (Moll et al., 1992, p. 133). For this piece

of the analysis, the focus will be on first-generation/ low-income (FGLI) and Black, Indigenous, and People of Color (BIPOC). As Verdin et al. (2021) point out, the funds of knowledge framework explains that learning occurs within households, not just in classroom environments. For most FGLI students, the acquisition of such knowledge often comes from manual or skilled labor (Smith and Lucena, 2015). In an engineering classroom, however, the skills and knowledge these students possess are not valued, forcing students to negotiate their values and those favored in the classroom. Most of the existing literature conceptualizes FGLI students based on academic performance, positioning them against normative ways of learning and thus promoting assimilation to the current higher education beliefs in which their lived experiences are not valued (Ives, 2020). The funds of knowledge framework allows students to incorporate engineering into their core identities by acknowledging that learning can occur within their homes (Verdin, et al., 2021). Further, by acknowledging the ability of low-income and BIPOC parents to support and nourish their children's learning, a counter-hegemonic response is formed in which marginalized students are learning from households that are more than their economic status.

Because educational research on FGLI students often focuses on the systemic barriers they face and the persistence they must face, little is known about who they are as learners. As a result, educators move away from sociocultural approaches to learning (Ives, 2020). Smith and Lucena (2016) point out that when the funds of knowledge of undergraduate engineering students who grew up in low-income families are acknowledged, they can establish a sense of belonging. Among the participants in their research students, students that were able to see their background as valuable did so by coming to recognize funds of knowledge and creating their own definition of what engineering is and who engineers are.

1.2.2 Cognitive dissonance and its outcomes

When the funds of knowledge or the cultural wealth of marginalized students are ignored, they feel forced to change their knowledge and behavior to fit in. In 1957, psychologist Leon Festinger coined the term cognitive dissonance. Cognition is the “belief about the environment, about oneself, or about one’s behavior (Festinger, 1957, pg3).” Broken down, cognitive dissonance is the perception of conflicting information. According to Festinger, one of the ways in which cognitive dissonance occurs is when new information, which contradicts existing beliefs and values, is revealed to a person. To mitigate cognitive dissonance, the person must either change an action or change their beliefs. In either case, there is no guarantee that cognitive dissonance will be eliminated. In an exploratory study, Light (2007) noticed that while men in engineering reported higher confidence intervals than women, they did not perform better. Light (2007) hypothesized that through alignment between expectation and experiences, and therefore the mitigation of dissonance, the students required fewer radical changes in their behavior or knowledge.

One of the possible mitigation strategies for cognitive dissonance is racial code-switching. The majority of the literature that will be described focused on the racial code-switching of Black people. Though the experiences of Black and Latine people are not the same, there does exist *some* common ground for both that can provide insight into the motives behind racial code-switching in the workplace or academic institutions. Racial code-switching was described by McCluney (2021) as the strategy in which Black people “adjust their self-presentation to receive desirable outcomes through mirroring the norms, behaviors, and attributes of the dominant group” in places like classrooms or the workplace. For racially minoritized groups, especially for Black people, the changing of behavior has been used to navigate White spaces. Though racial

code-switching is used as a management strategy, it also encourages White professional standards as the norm. In their study, McCluney (2021) studied two scenarios in which Black and White participants overall perceived employees who racially codeswitched as more professional. Because White men have retained the authority to shape the definition of professionalism (the possession of knowledge), people from marginalized populations may feel forced to adhere to these norms to be perceived as professional. Even companies with diverse leadership or a diversity statement have shown bias against Black-sounding names. In exchange for employment opportunities, many Black workers opt to adjust how they “dress, think, and act” (Cross and Strauss, 1988 pg. 273; McCluney, 2021). For Black women, these issues are further exacerbated when they are forced to confront the historically imposed stereotypes of being angry (Wes, 1995; Jones and Shorter Gooden, 2004). Black women are often pressured to engage in identity shifting, the alteration of speech, actions, and appearance to adjust to cultural norms by adopting dual identities that appease both White and Black communities (Jackson, 2002; Bell et al., 2003). To mitigate the increased negative scrutiny, Black women may be motivated to behave in ways that reduce their distinctiveness and increase their perceived belonging to reduce their susceptibility to stereotypical expectations and discriminatory actions. To contest the negative consequences associated with discrimination, Black women may alter their actions and language to fit within a given environment (Dickens et al., 2019).

Racial codeswitching can offer employees from minoritized groups opportunities for mobility in the workplace, but by doing so, it also reinforces White professional norms, which can continue to encourage White people to believe that their own values are the professional standard. As a result, White people may begin expecting racial codeswitching and may continue to judge others

based on whether or not they embody White behavior or appearance (McCluney, 2021; Banda et al 2012).

1.2.3 Imposter Syndrome

As minoritized students begin believing that the knowledge and values they possess are not important, feelings of estrangement in academic and professional fields become more common. The concept of the “imposter phenomenon” was originally described in a 1978 study that focused on high-achieving women (Clance and Imes, 1978). Despite the outstanding accomplishments of the women in the study, they believed that they were “really not bright and [had] fooled everyone who [thought] otherwise.” Imposter syndrome, a development of the imposter phenomenon, is a term frequently used in spaces of marginalized communities to define a feeling of discomfort and a sense of estrangement, particularly in academic and professional settings development (Tulshyan and Burey, 2021). Though early imposter syndrome literature exists, much of it fails to explore the root of its existence or the role systemic racism and other biases play in its development (Tulshyan and Burey, 2021). The early definition blames the individual, furthering the idea that marginalized populations need to be fixed instead of the places in which imposter syndrome exists. This understanding of frames imposter syndrome as a personal flaw instead of a byproduct of structural oppression (Wright-Mair et al, 2023). Tulshyan and Burey (2021) explain that White men’s intelligence is validated over time because they’re able to easily find role models who are like them, something marginalized individuals cannot.

Unfortunately, most BIPOC students who attend predominantly white institutions (PWIs) find themselves in environments that are historically rooted in ideologies of White supremacy. Recent

work portrays imposter syndrome as a product of oppressive societal systems which produce inequities for marginalized populations (Tulshyan and Burey, 2021). Because academic success has long been linked to Whiteness, racially minoritized students are expected to code-switch with PWIs and remove themselves from their identities. A deficit lens, in this case, fuels arguments that populations like Latine students are not likely to find common ground between their cultural values and those present at PWIs, resulting in feelings of imposter syndrome. In a study on Latine students in higher education, “consejos” was conceptualized as a key factor for Latine students to develop what is referred to as “pedagogies of survival” (Campa, 2013) which stem from funds of knowledge. When Latine parents were not able to attend college, they gave their children “consejos” to encourage them to pursue a level of education they could not. This approach provides students with hope and purpose, encouraging them to defeat the obstacles they will face at PWI’s (Delago- Faitan, 1994). On the other hand, FGLI students may also feel disloyal for leaving home and guilty from peers for being “selfish, fake, or display by leaving home to go to college or trying to better themselves” (Holden et al, 2021).

1.2.3 Intersectionality

The process of self-authorship, cognitive dissonance/code-switching, the acquirement of funds of knowledge, and feelings of “imposter syndrome” are all both heavily influenced by and influence a person’s identity. Through an intersectional lens, researchers are able to better understand a student’s experience by accounting for all identities rather than trying to isolate a single one (Crenshaw, 1991). Likewise, intersectional analysis becomes an important framework for theorizing and understanding identity (Gines, 2011). Literature on the experiences of

marginalized students tends to focus on race and ignores the role of socioeconomic status under the belief that Black and Brown students are usually low-income (Smith and Lucena, 2016).

Though race, gender, and ethnicity all interact with socioeconomic inequalities, class shaped the ways in which students will experience race, gender, and ethnicity. Combined, these identities play a role in the development of an engineering identity. This research paper must, therefore, use an intersectionality framework.

1.3 Theoretical Framework

The following paragraphs describe concepts that informed the analysis.

1.3.1 Disciplinary Values

The devaluation of certain skill sets, primarily those of non-White and wealthy male students, has led to an emotional struggle for these students and has ultimately forced many to change their own beliefs to ones that are values in engineering. As the field of engineering shifted from trade to profession, its application focused on the usage of math and science in military, industrial, and commercial sectors (Riley, 2008). Engineering students are taught to think in an analytical manner and to remain objective for the purpose of problem-solving. The field has created a set of disciplinary values that favor this analytical problem-solving (Riley, 2008), academic rigor (Riley, 2020), and meritocracy (Rohde, 2020). Though the ability to solve complex problems is one of the fundamentals of engineering, this can result in many undergraduate students remaining isolated from learning about ethics and social justice.

Problem-solving in “Power Countries” like the United States, China, and Germany has furthered an individualistic mindset in which engineers do not question the validity of their assumptions because they lack the context of the larger problem (Riley, 2008). This is further exacerbated when the engineers working on a complex problem do not have the critical skills to understand the harmful impact the solution will have on marginalized communities. It is important that undergraduate courses prepare students for the engineering problems they may face, but as Riley (2020) points out, the emphasis placed on academic rigor further isolates ethical issues from engineering. Additionally, it creates an environment in which success is hard to achieve thus making engineering meritocracy even less attainable. Engineering meritocracy veils itself as a reward system for students with “strong work ethics,” but by doing so, overshadows the structural and historical barriers that exist for marginalized students in engineering (Rodhe, 2020). Even students who believe that anyone could be an engineer ultimately fall back on meritocratic values when asked what skills or values are necessary to be an engineer (Rodhe, 2020).

Marginalized students often have to wrestle with disciplinary value interpretation, a process Vakil (2020) defined as a “student’s reflection on the values of the disciplinary domain and who they may become in relation to said domain.” Vakil (2020) points to three central themes that have distinguished the relationship that exists between learning and identity: opportunity, navigation, and values. Even if advanced STEM courses are available for students of marginalized identities, learning opportunities are largely denied due to cultural and social barriers. Because learning is a cultural process, students’ identities will either feel supported or constrained and often, they are constrained. Minoritized students must also learn to navigate White-dominated spaces, leading to a racial identity that interacts with STEM learning in

consequential ways. This is further complicated by the settled values of science and engineering which favors the White, male, and wealthy (Riley, 2008). Consider a case in which low-income students of color are given the opportunity to work with a civil engineering firm. The project is aimed at expanding the city by clearing space near their low-income community for the usage of “trendy” restaurants and shops. In this scenario, the students will wrestle with disciplinary values, questioning what kind of person they will become if they decide to pursue a career path that can displace people from their community. Engineering values may force the students to think about efficiency or space maximization, but this will be in direct conflict with the safety of their community. As a result, the students will experience cognitive dissonance.

1.3.2 Self-authorship

One of the possible journeys a student can take as they negotiate disciplinary values is self-authorship. The concept of self-authorship was first defined by Kegan (1994) to describe the ability to define one’s beliefs, identity, and social relations. According to Kegan (1994), a self-authoring mind decides for itself what to value and what to believe. In other words, to achieve self-authorship, one must have internal authority that is independent of the beliefs and values of external authorities. Researchers have emphasized the importance of emotional, social, and cognitive development in creating effective learning environments (Sattler & Turns). Baxter Magdola’s (2001) work brought forth the need for educators to appropriately support student development by “propelling students toward self-authorship.” In such a scenario, an educator must disrupt a student's way of making meaning. A student will then either fit the disruption or begin the process of self-authorship. As stated by Pizzolato (2003), students come to college with

existing assumptions about knowledge and think in binary (i.e., right or wrong, good or bad). As students continue to gain experience throughout college, they begin to think more broadly and will therefore need more support from educators when learning. However, studies on self-authorship, like that of Baxter Magdola (2001), focus largely on White students. Pizzolato (2003) has centered self-authorship research on marginalized students but studies like these are few and far between. In this study, Pizzolato (2003) found that students who possessed low levels of privilege developed “self-authoring ways of knowing” before attending college and arise from a student’s willingness to process experiences.

2. Study Design

2.1 Research question

In this study, I explore how disciplinary values interpretation and self-authorship overlap with the portfolio creation process through an intersectionality lens, answering the following question:

What elements of my experience in engineering surfaced during the portfolio-creating process and, in turn, influenced the portfolio choices I made?

2.2 Researcher positionality

I am a first-generation/low-income (FGLI) college student, a Woman of Color (WoC), and an immigrant. Throughout my life, I have come to realize that one identity cannot be separated from the rest. I am an equal part of all. Experiences of discrimination within engineering have come in

the form of webs that are impossible to detangle (Ong, 2020). The scenarios shared during the research study and other moments throughout my life not mentioned are manifestations of racism, sexism, classism, or xenophobia and more often than not, these came in groups.

Attending a Predominately White Institution (PWI) to pursue a career that has been dominated by White men has heightened the severity of these scenarios and led me to question not only my worth in the field but also my belonging.

When I was asked to co-research a portfolio research study, I agreed in hopes of highlighting the facets of discrimination that have come with engineering and the influences these experiences and a student's background play in their description of what is considered an engineering project and who is an engineer.

2.3 Participant selection

In 2021, I was one of nineteen second-year mechanical engineering students enrolled in a portfolio course at Tufts. This course was part of a larger research study on the integration of ePortfolios into mechanical engineering undergraduate learning. At the end of the semester, I was interviewed about my experiences with the portfolio course by an undergraduate research assistant. During the interview, I shared the challenges I faced in deciding which projects to include because I believed that my identities clashed with that of engineering. One of the two professors of the course, Briana Bouchard, proposed that I join the team as a co-researcher to provide an authentic analysis of my experiences. The remainder of the data was collected over five months, during which Briana and I met weekly. The sections that follow analyze said data.

2.4 Methodological orientation

The analysis of this thesis is largely aligned with case study methodology. When analyzing qualitative data, many engineering education researchers may not reflect on the lived experiences of their research participants, possibly ignoring impactful findings and creating false narratives. Researchers of color have called for opportunities to self-reflect on lived experiences through auto-ethnographies (Holly, 2020). Though the research conducted did not follow autoethnographic traditions because of its collaborative nature, the methodologies were deliberately chosen to create equitable interactions between researcher and participant by transitioning my status from participant to co-researcher. In doing so, I was able to place my voice at the center of the work and offer insight into all aspects of the study.

In a similar manner, Martin and Garza (2020) attempted to shift the research-participant dynamic by taking a collaborative approach. Garza, a WoC and the research participant, conveyed her story through excerpts in the paper. Martin, the researcher, was involved in the analysis of the findings and was effectively another author of Garza's study. Though Martin and Garza (2020) claimed to write an autoethnography, they defied its purpose by having a second and White author in which Garza's story was not the focus. As Holly (2021) points out, the topics that Garza explored were not reflected in the literature. In this study, the researcher had both an academic and racial position of privilege. Though it is important that researchers attempt to disrupt the current approach to studies involving marginalized students, Martin was unable to balance the power between herself and her research participant. Taking inspiration from Martin and Garza (2020), and the critique from Holly (2021), Briana and I created a research collaboration that allowed me to join the research as an equal collaborator. Because there was

involvement from another person, the analysis was led by an intrinsic case study (Stake, 1995) and participatory research (Seale, 2010) rather than a true autoethnographic method.

2.5 Data collection

Before I was officially a co-researcher, I was a participant in a study that examined the perception of portfolio development for a hybrid ePortfolio course offered in the mechanical engineering department. In the first interview, I was asked by an undergraduate research assistant to explain my experience in developing the portfolio and to compare the portfolio development process to traditional exams. My response was in relation to my experience taking the course remotely. The data collected from this interview was transcribed and served as only a secondary data source.

Four months later, after I had taken on the co-researcher role, an additional interview took place and was used as the primary data source. One of these interviews took an open-ended approach (Patton, 2002) and was conducted virtually. Briana, my professor, and co-researcher, asked two questions (1) Why had I chosen not to include some content in my portfolio? and (2) If I had to create a portfolio again, would I make the same choices or have my perspective on what to include changed over time? For the second interview, Briana and I collaboratively designed the research and followed a more informal conversation interview (Patton, 2002) in which Briana asked questions naturally as they arose. Each interview summed to 57 and 83 minutes, respectively, and were transcribed.

2.6 Analysis

A core aspect of the data analysis approach was that of collaboration. After both interviews had been completed, Briana and I met to watch the interviews together virtually. We took individual notes and paused during moments we found significant. We continued to meet to discuss the themes and critical moments that appeared in the interviews. Two cycles of coding took place in which Briana and I were able to have more in-depth discussions that helped us align the codes that were selected (Saldana, 2015).

The first coding cycle was also collaborative in nature and resulted in a list of preliminary codes. These codes encapsulated the elements that were influenced by portfolio changes and my experience before and during my undergraduate journey at Tufts. For the second coding cycle, Briana and I coded the transcript independently, using the preliminary codes. We met once more to discuss and isolate the codes that were applicable to elements that influenced my choices in the portfolio development process and my experience in engineering. The final list of codes reflected said elements and monumental choices that revealed my experience: *the definition of portfolios, the definition of engineering, employers defining engineering, pathway for racism to flow, funds of knowledge, guilt, imposter syndrome, comparison to peers, engineering consumerism, and resource consciousness.*

3. Findings

The analysis produced a list of elements of my experience in engineering that were both revealed by the portfolio and influenced my choices about what to include and not include in the portfolio.

These elements are the (1) *definition and usage of portfolios*, (2) *definition of engineering*, with sub-elements of *employers defining engineering and portfolios*, and *engineering as a pathway for racism to flow*, (3) *engineering consumerism*, with a sub-element of *resource consciousness*, (4) *funds of knowledge*, with a sub-element of *guilt*, and (5) *imposter syndrome*, with a sub-element *comparison to peers*. While many of these elements interact and overlap, they each offer unique insight into the experiences I had in engineering and the influences I experienced as I crafted and re-crafted her portfolio over time. The following section will provide an analysis of the quotes from the interviews. Each finding follows a chronological flow in which I first talk through what I experienced before the portfolio course, then a quotation from the interview, and finish with a description of what I think now.

Draft 1: The About Me section included my favorite past times outside of engineering; the portfolio included projects I had worked on with my dad that used scrap wood; the main page had a link to how indigenous knowledge advances modern science and technology.

Draft 2: The link to how indigenous knowledge advances modern science and technology was removed, as well as the projects I had worked on with family members. The About Me section was re-written to include engineering skills learned in classroom settings (i.e., Solidworks).

Draft 3: I added a tab that discussed the importance of equity and an explanation as to why the family projects I had included were valuable.

Draft 4: I removed the tab for equity and reorganized project lists to “building,” “internships,” and “papers.”

Draft 5: Family projects were added back to the projects list, but their descriptions still focused on corporate terms like “cost-savings” and “optimization.”

Figure 2: Timeline of what changes occurred in the portfolio throughout and after the ePortfolio course.

3.1 Definition and Usage of Portfolios

In the Spring of 2021, I decided to take a portfolio course offered by Briana. The portfolio was introduced as a website in which we were left to make our own decision on what to add. The little knowledge I had on portfolios had been gained from YouTube videos that described portfolios as an essential part of the interview process for engineers. Portfolios, as the YouTubers pointed out, should include only engineering projects with skills your dream company would want. In the weeks that followed, I felt pulled between who I was and who I thought engineers wanted me to be. If I excluded projects that showcased skills I learned from my family, which perhaps to some companies may have seemed unfitting, I was accepting that there was only one way to define the engineering field. Thus, a portfolio, to me, represented much more than a website; it was deciding between my own identity and one I thought people would accept.

During our weekly class times, we would have the opportunity to share our progress and get feedback from peers. Openly sharing the ideas I had about adding family projects to my portfolio made me feel exposed, and though there were no negative comments in return, I found myself feeling overwhelmed.

... having conversations with other people in the class was helpful because at least I knew that they that me questioning what engineering was made them wonder like “is this really what engineering is?” And I think having those conversations is important, so I think portfolios have the ability to create these kinds of conversations and the ability to help students like myself realize that it’s not that we don’t fit the description of engineering it is that engineering doesn’t include us.

Throughout the course, I had gone back and forth between portfolio ideas, one in which I shared more about my background and identity and another that felt like the safer option. Because I had never seen myself represented in engineering, the task of choosing which projects were related to engineering was difficult. The process of creating my own standard of what was an engineering project allowed me to feel genuine ownership of my learning and more confident identity in engineering.

3.2 Definition of Engineering

With limited work and education opportunities but extensive knowledge of our environment, my family relied on the farmland for survival. Old car parts were reused, plants were turned into medicine, and rocks were made into a shelter. From the moment I was born, I was exposed to a science most are unfamiliar with. This, however, was not something I realized until after taking the portfolio course. The more time I spent pursuing my career goals, the less clear the definition of engineering became. It seemed like whatever that definition was, it didn't include people like me. After years of self-discovery, one that had a pivotal moment during the portfolio course, I decided I no longer cared for a definition that did not reflect the essence of engineering, which to me relied heavily on its impact on my community.

I think, part of the process was also like dismantling the way I saw engineering, because it did make me question like Why is this the way I see engineering? Is this something I believe, or is this some definition that other people made me believe? And so I think part of creating a portfolio was a lot of self-discovery and I do think that that was like the first point when I started questioning like what can be done within engineering and if this is

the definition that we're going to always stick with, and I think the portfolio process exposed the way engineering was defined.

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... I had always grown up with this idea of you don't really need like super expensive equipment to do things like you can just do it yourself. And the way I had grown up seeing engineering or seeing the STEM field, was the way my grandpa lived it.

A bit after the portfolio course ended, I gained a new perspective on my identity in engineering. There was no single event that led to the realization, but it was instead triggered by my experience in creating a portfolio. At this point in my personal and professional life, I felt much more comfortable with the way my skills and personality influenced my thinking, and ultimately, my identity as an engineer. The more engineers I met, the more obvious it became to me that we are all vastly different and we all view engineering from a different angle.

From my angle, my grandfather, Apolonio Martinez, was the engineer that inspired the definition of engineering I have settled on. Though my grandfather was not an engineer by degree, he manifested all the qualities that make an engineer. With tools and his hands, my grandfather designed farming equipment and housing appliances that helped his family survive. His innovations are the breadth of what I consider engineering.

3.3 Employers Defining Engineering

Junior year of high school, I interned at an engineering company for the first time. Every summer since then, I have worked with engineers to build, test, and analyze various problems. Despite the level of experience I had and the encouragement from my mentors, I had a difficult time accepting that the methods by which I gained my skills carried the same weight as more traditional and socially acceptable approaches. When I took the portfolio course with Briana, I had already decided that the portfolio I would create would be used for future internship applications. Out of fear of not fitting the mold I believed employers wanted, I relied heavily on others' opinions and online content. The feeling of insufficiency solidified, and I decided to remove any remnants of my identity from my portfolio.

... I am taking this course, where I'm including, I'm creating a portfolio about myself. But here is this definition that I had already come up with in my mind beforehand about the idea that portfolios are only for employers and that you have to fit a certain description, because in the videos they said, like what kind of projects, you should include or how to word things so that employers would like them. And so I think, to me, it was also a struggle to really know like what was my end goal like what did I want my portfolio to really showcase and I think during that point, I was like well if this is a portfolio about myself and for myself, then why don't I just include projects that I'm excited about um, and so I had found pictures that I had about projects we my family had worked on in Mexico, and so I included those. And I think it was always just like constant tugging back and forth between fixating on what I thought employers wanted and what I wanted.

Although I did not grow up building LEGO sets or knowing I wanted to be an engineer, I had a deep passion for using my hands to build. I had spent most of my Sundays watching my family use scrap wood to build shelves and deciding what part of our car to fix simply by the noise it made. Engineering to me was simply a method of applying imagination and experiences to build and save money. It took time to accept that the skills I have gained from experiences only low-income and immigrant families face are as valuable as those learned in engineering classrooms.

3.4 Pathway for Racism to Flow

For generations, my family lived in a small town in which corn was the most prominent crop. My grandfather would tie a piece of wood to two donkeys and would stand on this piece while the donkeys dragged him across the field. The wooden piece held sharp nails and seeds that would shorten the time he would need to stay on the land. A generation before, we used a shovel, and three generations before then, we used our hands. Though my family was never college-educated, they were able to survive a life in which doctors were too far and grocery stores were too expensive. These practices originated from Indigenous communities. When I began taking science classes in the United States, I realized that science from back home was not considered “real” science here. Not much later, I began to believe that I had not grown up in a community of scientists and engineers and thus allowed this to influence the choices I made about my portfolio.

... engineering in general is very white and I- one thing I noticed when we were in a portfolio is is that a lot of people had like very similar skill sets and very similar experiences. Um and I've I've had presentations before where I presented like how a lot of, a lot of people don't really acknowledge indigenous people it's like scientists or

engineers, even though they have been engineers and scientists for a lot longer, and so one of the topics I wanted to have was specifically about like indigenous populations and then links to all the projects that indigenous people have worked on that aren't necessarily like considered real science or engineering because it's not Western. Um and so that was one thing that I really wanted to include but I decided not to because I was kind of scared that some recruiters are going to find it like too controversial for that that was going to basically like cut me out from them even considering me for an application.

Engineering as a field is affected by those who practice it. In many ways, engineering has been used to fulfill racist agenda. The design of technologies that were used to exploit enslaved people in the late 18th century, medical tools used to harm immigrant women, blood pressure monitors designed for White people, and so many more inventions highlight the many ways in which engineering cannot be perfectly isolated from the engineer's beliefs.

During the portfolio process, I feared being "too political" by sharing pieces of my identity and how growing up as a low-income WoC made my approaches to engineering design problems different. But as I have gained more experience, and engaged with more engineers, I realized that I am not the one who makes identity political, but rather the people who see it as a threat. It is important that people are reminded of the many ways in which underrepresented populations have contributed to the advancements of the sciences. Though I felt a certain responsibility to share these stories, it should not be expected that other underrepresented students do the same. I was lucky enough to participate in a portfolio course in which no student or professor created a hostile environment and consequently allowed me to begin this journey.

3.5 Engineering Consumerism

When I began adding descriptions to the projects I included in my portfolio, I began to reflect on what a career in engineering really meant. Engineering to me opened a path to healing the neighborhood my family had left in Mexico. Originally, that meant a career in environmental engineering. But as I began taking courses in robotics, I decided mechanical engineering was where my passions truly laid. The more exposure I got, the more I realized that at the very core of engineering existed consumerism. New iPhones with slimmer appearances, lighter laptops, self-driving cars, and delivery processes that take less than a day, had all been created by engineers. The descriptions I gave for my projects reminded me of that. I wasn't truly helping people, much less my community, by designing products that were not financially accessible.

At that moment, it felt as if I was giving up my identity by becoming an engineer. If I chose to continue the engineering path, I would be renouncing my community. When finishing the descriptions of my portfolio projects and discussing what I had learned from them, I thought I had made my choice.

And when I decided to go into engineering, it was because I, I actually wanted to do civil engineering at first. I had met an engineer in sixth grade who created wells in Latin America to help families or communities that didn't have access to clean water. And I had grown up hearing stories about my mom and her family, like the nearest, the nearest source of water was like a mile away. And so they would have to like take a donkey and the donkey would have like buckets of water, and they would fill it up and then you go back home. And they had one single source of water, where they would feed the animals or they would irrigate crops or they would wash their dishes where they would shower,

and where they would get water to drink and cook. And so to me like seeing this engineer, who is able to use engineering to help communities, like my own, I think was the first time I saw engineering and and to me it was like I can use engineering to help families. And when I came to college, I think that idea started to shift, because what we learn in classes are more business oriented. So it's like product optimization or innovative ways to make work like easier for other people, so that...it feels very exploitative to me now and that wasn't really what I had grown up with. And so, when I was creating a portfolio the flow I wanted was one that was more business oriented, one where I would show like I had designed this, and this is exactly what I did using the skills that I learned from classes.

Not everyone has been lucky enough to live in a community unharmed by engineering. From the racism embedded in technology to the methods of acquiring natural resources, engineering has been devastating when practiced incorrectly. To avoid such a path, it is invaluable that engineers understand the historical and social implications of engineering design.

3.6 Resource Consciousness

Before moving to Boston, I lived in a neighborhood of Mexican immigrants in Dallas, Texas. My dad had found a stable job that paid him more than minimum wage, which allowed my mom to stay home with her five children. We always had enough money for food and rent so we considered ourselves lucky, and we were. When I first came to Tufts, I was utterly shocked by the amount of wealth seen on campus. Students wearing thousand-dollar winter coats, parents

driving cars we would only see onscreen, and college tuition paid for four years in advance. I had never been more aware of my socioeconomic status until I came here.

Once I began taking engineering courses, the wealth gap became more visible. Students would call their parents for money to buy tinkering kits, or for networking assistance to secure a summer internship. This felt repeated when we began sharing our portfolios. There would be projects of robotic arms, cases for an at-home 3D printer, and other things that I had either no exposure to or the money to afford. I felt embarrassed when comparing their projects to my own.

And a lot of those projects included ones that I had worked on my family with or things that didn't really use like advanced technology, because most of them were using natural resources or reusing materials.

Taking classes in which people didn't see my family's projects as remarkably as I did was one of the harshest realities of resource consciousness. What I showcased was simply seen as different, and although they were, to me they held more value than course projects in which I was not granted an opportunity to use my own skills and ideas. When working on my initial portfolio, I was targeting employers and included projects I did not feel any connection to. It made me wonder if the projects wealthy students publish are ones they care about or just additives they also believe fit the standard description of engineering.

3.7 Funds of Knowledge

When my family lived in Mexico, the primary method of survival was to use the resources our land provided. The vegetables that were grown were sold or used to make food; cows and goats

were used for milk and meat; and nature's resources gave us tools to build a shelter. After we moved to the United States, there was no longer a need to live off the land. But money did not come by easy, so we relied on skills from the farm and what we observed Americans do to accommodate to a new life here.

To assimilate, my family and I began losing some of the cultural connections to our home country. The TV shows and books I read helped me perfect my English and the over-pronunciation of words led people from my community to believe that I was becoming too American. There weren't any college students or graduates in my neighborhood, much less those who majored in engineering. Before even beginning the portfolio, I had separated engineering from the rest of my life because I believed they were two parts of me that could not intersect. As a result, I was not confident in my perspective of engineering or engineering projects.

After I had selected projects that seemed to be a better fit for a portfolio, I began to write their descriptions. I was careful not to include information that exposed parts of my identity. I wanted whoever saw my portfolio, especially employers, to not see me as different.

And so, when I was creating a portfolio the flow I wanted was one that was more business oriented, one where I would show like I had designed this, and this is exactly what I did using the skills that I learned from classes. And I felt like I didn't really have space to include stuff that I had used from my background or knowledges I had come from my family.

It has been difficult, practically impossible to separate engineering from my life outside of it. The way in which my family taught me to look for and use resources is something that I unintentionally apply to every project, regardless of what environment I am in. Everything I

know has been passed down generations and is what kept my family safe and healthy despite the harsh poverty. Today, I find myself taking similar approaches to engineering projects, consistently finding ways to make something work or looking for the least expensive alternatives. While these skills were not ones we chose, and frankly would not have chosen if the circumstances were different, they are still a part of who I am.

3.8 Guilt

From a very young age, I knew how different I was from the other students in my classes. The visible differences pushed me to begin hiding what was not as obvious: my socioeconomic status, family relations, and personal beliefs. This behavior returned when beginning classes in college. As I became aware of the wealth and whiteness to which I was now in the middle of, I caught myself code-switching trying to mimic the way students at Tufts behaved. During the portfolio course, this translated to hiding details about my identity in engineering projects.

I felt guilty, because I decided that projects that my family and I had worked on weren't good enough... And so I think part of the reason I felt guilty was because it almost felt like I was embarrassed to showcase what my family did because I thought that that didn't really fit with the flow of my portfolio.

Guilt has been a byproduct of shame, originating from the suppression of my identity. The guilt, however, seemed to be more bearable than the isolation I always saw coming if I showcased projects my family had worked on. If engineering had been presented to me in ways I felt

included, then perhaps this journey would have been guilt and shame-free. Unfortunately, that was not and is still not a reality that other underrepresented students face.

3.9 Imposter Syndrome

When I reflect on the thoughts and emotions that flooded me when taking the portfolio course, I find some of the same imposter syndrome I felt back in middle school. I remembered how humiliating it was to be asked by my seventh-grade science teacher to stand up and spell out the word “monkey” in front of the class until I said it correctly because I did not understand the difference between a single “k” and “ck.” The familiarity of loneliness in a room full of people that only seemed to feel sorry for you; thinking that maybe the discomfort I caused to students in my seventh-grade science class was similar to what I caused in other engineering students, professors, or employers that had heard me discuss why I considered certain projects engineering. After all, why would I know more about engineering than them?

I think what what would have helped me was that if I had shifted my intended audience to what I saw as an engineer to someone I had grown up with that I had seen as a representation of engineering So for me that was my grandpa. So if I would have created a portfolio for my grandpa, I would have been a lot more open about my identity. And I think it is important to also acknowledge that, like this is going to be shared and that we shouldn't include stuff that you don't want public. But I, I feel like we all, a lot of us feel like we don't really belong within engineering. And it's difficult to, think of yourself, otherwise

...having a portfolio is just a really nice summary of everything you did. And I um I've worked with like with underrepresented students a lot before and I'm an underrepresented, students and I think that having like a portfolio is something I didn't even notice this thing and so whenever I started working on it, I was a I think a lot of my imposter syndrome like started dying away a little bit just because I was able to list out things that I had done and things that I had learned.

Imposter syndrome is unfortunately something I don't think I will ever overcome. Though I do not fear discomfort anymore, I acknowledge that it is still a challenge to consistently must point out the prejudice and evident racism within engineering. The portfolio process allowed me to reflect on the path I have taken to be here and on the disparities between engineering projects for students of different ethnicities and socioeconomic statuses.

3.10 Comparison to Peers

When I began looking at other portfolios for inspiration, I noticed a trend of at-home projects my peers had completed. Some had 3D printers and designed a cover for it, others had made robots for fun with parts their parents bought. The projects my family and I had made looked nothing like that. The materials we used were scraps of wood from my uncle's job, nails we somehow had all over the house, and other random material that wasn't very aesthetically pleasing but fulfilled their purpose. Seeing my projects side-by-side with my peers' projects made me question whether I had misunderstood the meaning of an engineering project. I decided to remove these projects for fear that employers wouldn't draw a connection between my

socioeconomic background and projects and so they wouldn't conclude that I wasn't as "motivated" as the others.

And when I saw that compared to like one of the other people's portfolio pictures I had like a robotic arm, I was like, I began to wonder whether my vision of what engineering was was distorted or that, maybe the projects that I thought were engineering really weren't. And so I kind of felt ashamed that I had put those projects because they didn't seem as innovat— innovating as the ones from the other students, so I decided to remove them and stick with the projects we've had worked on during school.

From a historical standpoint, we have always been engineers and scientists. Imposter syndrome coupled with my comparison to peers resulted in a battle between who I am and the person who could be more like the remainder of the engineers. But I did not choose to engineer to be like others; I chose this career to help communities that have been hurt by the imperfections of this field.

4. Discussion

The experiences shared illuminate the opportunities and challenges portfolios may create for students from groups historically marginalized by engineering to engage in the processes of interpreting disciplinary values and self-authorship. By looking at the elements of my experience in engineering that were revealed by the portfolio and influenced my decision-making, it is possible to understand what disciplinary values students are perceiving and accepting or challenging and the ways they may be able to engage in self-authorship. In this section, I will

explore the disciplinary values illuminated by the elements outlined in the findings. I will also discuss how interacting with those elements and disciplinary values through the portfolio contributed to my self-authorship. Within the elements presented in the findings, several disciplinary values that have been previously noted in the literature come to the surface.

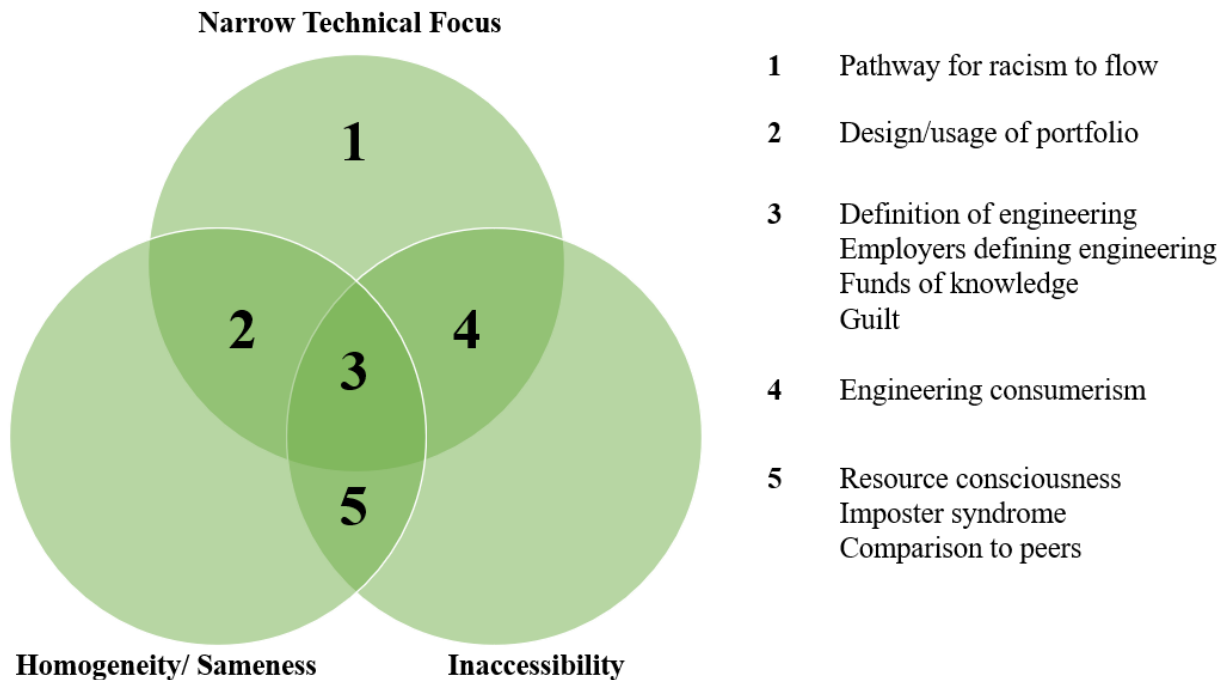


Figure 3: Venn diagram representing the ways in which the findings fit into disciplinary values of engineering.

4.1 Narrow Technical Focus

As a profession, engineering has historically excluded marginalized communities, both within the population that composes it and within the engineering design process. The academic focus for most engineering disciplines lies within a narrow technical focus (Riley, 2008), often leading

to a group of professionals that are unable to question the morality of their work. Engineers are taught to solve the world's toughest problems, but to whom are their solutions beneficial? Technologies like the Cotton Gin (Becket, 2014), medical oxygen sensors (Keller, et al., 2022), and AI tools (Buolamwini, 2019) that have harmed Black communities were designed and built by engineers. Likewise, bombs, state-of-the-art war weapons, and improved tracking systems that have killed millions of low-income Brown communities have also been created by engineers (Hacker, 2017). As mentioned in *engineering consumerism*, my idea of what engineering was shifted from one that helped communities like mine to one that was heavily influenced by product optimization and monetary gain.

Academic institutions play a key role in the development of students as engineers. Currently, course requirements for engineering students are limited to technical courses and there is little room for Humanities or Social Sciences courses. These courses provide White and wealthy students with the option and privilege of *learning* about marginalized experiences and the role engineering plays in that marginalization. For others like me, it was a *lived* experience. Most BIPOC and low-income students can think critically about the effect of an engineering solution on a marginalized community while White wealthy students cannot. The current narrow technical focus of engineering has and will continue to harm marginalized communities by limiting the learning of White and wealthy students. This is an issue I talked through in the first interview and *comparison to peers*. By sharing my projects with White and wealthy classmates whose own portfolios were very technical, I began feeling overwhelmed with the responsibility of explaining the importance of my community's projects.

Companies also provide an opportunity to alter the state of engineering. Students who grew up in BIPOC and low-income communities are not able to showcase the technical projects most

companies look for. The hiring process is structured in such a way that most BIPOC/ low-income engineers may be seen as less competitive applicants because they lack some skillsets that are fundamentally based on resource access (Long and Mejia, 2016; Simmons, et al., 2017). Though companies aim for an increase in diversity, they are not willing to expand on required skill sets, therefore leaving out FGLI and BIPOC engineers or requiring that they be exceptional to be on the same playing field as White and wealthy applicants. As we have seen in the *definition and usage of portfolio*, I felt that the projects and skills she included were of lesser value than those of my peers. Unlike most of the students I shared my portfolio with, some of my projects used little-to-no purchases because money was the largest restrictor. This not only influenced the aesthetic appearance of the project but also the perception I had of my abilities as an engineer. When describing *pathway for racism* to flow in the findings section, I shared my fear of seeming “too political” for sharing pieces of my identity that interfered with my identity as an engineer. I went on to describe the vast differences between the engineering I had grown up seeing and that studied at school in *consumerism*. These pieces, coupled with my idea of what employers were looking for and what engineering was, led me to believe that my skills were not technical enough. Sadly, this is the reality more and more BIPOC engineers face as they are stereotyped (McGee, 2016), blamed (Martin & Garza, 2020), and deemed inadequate for the field (Holly, 2020). The usage of a portfolio allowed me to begin seeing my funds of knowledge as valuable through the process of self-authorship. When portfolios are introduced correctly, they can be powerful -and empowering- tools.

4.2 Homogeneity/ Sameness

In highly selective educational institutions, curriculums are designed to prepare students for their respective fields. For engineers, the foundational skillsets required in the field are achieved through courses that were selected for their rigor and compatibility. In *definition of engineering* and *funds of knowledge*, I note the harsh differences between the engineering skills that are taught in class and those used by my family. As I began to identify patterns in my peers' portfolios in, described in *comparison to peers*, I identified imposter syndrome as the reason behind removing some of these "unfitting" projects entirely. This resulted in my further belief that my funds of knowledge were invalid, which as Smith and Lucena point out, can inhibit a student's sense of belonging (Smith & Lucena, 2016). During the building of my portfolio, I had denied parts of my identity to "blend in" with the rest of my White peers. By doing so, I believed I would avoid seeming "unmotivated" to employers. Like me, many other Women of Color feel forced to disprove stereotypes about their community's intellectual abilities and sometimes find themselves suppressing aspects of their identity to fit in (Ong, 2020).

However, in the *definition of engineering* factor and its sub-elements of *employers defining engineering and portfolios* and *engineering and portfolios as a pathway for racism to flow*, we see that I begin to author my own narrative about what counts as valuable engineering. I held firm in my interviews that Indigenous science and engineering practices are engineering, even if I chose to exclude them from my portfolio. I was perhaps not yet ready to take the step to make my views public, but I was authoring my own beliefs based on my internal values, which is consistent with the initial stages of self-authorship (Baxter Magolda, 2008). [14] We also see that I begin claiming the knowledge I gained from my family as engineering in the *funds of knowledge* factor and its sub-factor of *guilt*. Though my guilt remained about again not claiming

these skills and experiences publicly, I took initial steps towards doing so. Through self-authorship, I was able to negotiate between my funds of knowledge and the skillset I perceived as acceptable, validating my identity in engineering along the process. Before I took the ePortfolio course, I knew of the existence of the skills I gained from my family. The process of self-authorship did not just help me accept or reject values of engineering but also pull in all of the values from my funds of knowledge.

4.3 Inaccessibility

As Slaton and Riley describe, Whiteness and maleness have traditionally been considered “desirable traits” within engineering in the United States (Riley, 2008; Slaton, 2015). Though more academic institutions and engineering companies have claimed to increase efforts toward diversity in the field, an exclusionary system has remained in place. Equal opportunity cannot exist when stipulating certain characteristics for *who* can be an engineer (Rohde, 2020). Students in Rhode’s study stated that anyone can be an engineer, but then contradicted themselves by listing qualities necessary to be an engineer, a statement I resonated with. Through *comparison to peers*, we hear about my feeling of being othered for including projects that were not consistent with the level of technical skills my peers used, pushing me to eliminate said projects and enter a cycle of imposter syndrome and guilt. During my re-introduction of engineering at an academic level, I came to understand that people like my family may practice forms of engineering, but they ultimately are not engineers because of their nontechnical practices and inability to access a degree, all of which are influenced by their socioeconomic and racial backgrounds.

While there has been an aim to increase access to engineering degrees, the root of such exclusion has remained intact (Long & Mejia, 2016). Even once students of underrepresented backgrounds have gotten access to higher education for engineering, the exclusion is exacerbated by difficulties related to culture. For many students, being able to align tasks such as engineering projects, problem-sets, or even assessments, to their identity prevents them from interpreting their inability to complete these tasks as a sign that they are incapable of succeeding in the field. (Rhode, 2022). Engineering has traditionally values skills and mindsets that point towards masculine ways of thinking (Riley, 2017; Rhode, 2022). Though I negotiated and discovered similarities between the skills I do possess (e.g., cost-optimization, machining) that align with the technical focus of engineering, I was unable to fit the traditionally male mindset Riley (2017) and Rhode (2022) point out. Further, I claimed elements of my existing identity that fit engineering-related tasks.

5. Conclusion

5.1 Influence of the portfolio

Unlike assessments, problem-sets, or other assignments common in undergraduate courses, portfolios are unique in that they provide students with the opportunity to explore their professional identity. In the portfolio course I took, the assignment was simply to create a portfolio. The kinds of information we could include were left for interpretation and as such, let us articulate what we believed to be engineering and what learning goals we achieved through the project we completed. In this context, portfolios have been shown to be a powerful tool that takes students into a cycle of engagement with disciplinary values and self-authorship. However,

portfolios must be introduced in a manner that acknowledges the many different skills and knowledge students possess. When building my portfolio, I heavily relied on the beliefs of others whose exposure to traditional engineering was deeper than mine. Though students were never limited in what they include, it can be difficult to create a sense of belonging that allows them to deeply explore their identity.

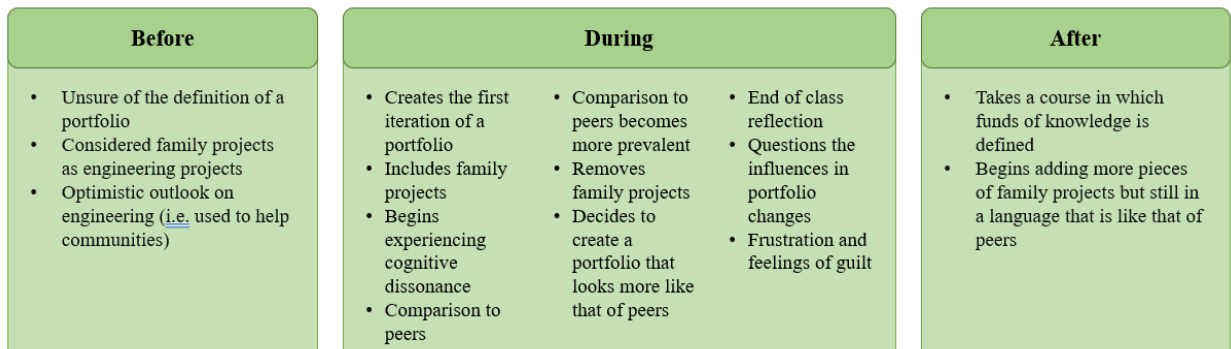


Figure 4: Changes to my portfolio before, during, and after taking the portfolio course.

As shown in *Figure 4*, the portfolio creation process can be lengthy and emotionally taxing. It is important that professors create an environment in which students' funds of knowledge are valued and supported. I was able to author my own definition of engineering and portfolios, but the results would have been different had I been in an environment in which I did not feel supported. Professors play a vital role in the journey students take when beginning their own portfolio creation process and many, especially those with marginalized identities, will need better support systems set in place.

5.2 Limitations

An important aspect of intersectionality is the acknowledgement of the influence identities play in a person's experience. As such, it is important to remember that the experiences and results shared in this paper are unique to me. It would be unfair (and impossible) to expect that the same outcome will occur for any student, regardless of the identities we share. What these results do point at, however, is that there is power in portfolios. Based on the results of this thesis, it is possible that in an assessment context, portfolios can provide a path for self-authorship (Sattler and Turns, 2015) that help students attain and retain a professional identity.

Since I was introduced to this research as a participant, there is an additional methodological limitation. Given the opportunity to author my own narrative, the transition to co-researcher from participant between the first and second interviews may have influenced my self-authorship. Further, the portfolio course and the research conducted had the involvement of professors at a predominantly White institution in which I felt comfortable. Previous interactions with the professors of the course relieved any fears I had of being devalued in the classroom by them. Further, the course was pass/fail, which removed the pressures related to grading and was not necessary to complete the core requirements of the mechanical engineering degree.

5.3 Implications

With the limitations of the study in mind, it is important to note the need for further research in the context of self-authorship for historically marginalized students through an intersectional lens. The literature review pointed at the limited literature that provided information about

students with multiple marginalized identities and when these students were included, one of their identities was typically ignored. Though the experiences shared were unique to me, one of the consistencies in results for many marginalized students is the role environment plays in our professional identity development. Students should not be expected to create an environment in which they feel supported to grapple with disciplinary values, it should be provided. Professors play an important role and have the responsibility of introducing portfolios safely in a way that gives marginalized students the opportunity to begin authoring their own definitions of engineering without feeling the burden of isolation as the “only one” in the class. The academic semester in which I was beginning my self-authorship journey was during heightened COVID restrictions and as a result, I chose to take the ePortfolio course virtually. During peer review sessions, I was placed in random groups and struggled the most with feelings of imposter syndrome in a group of mostly men. This is not to say that peer review sessions are inherently harmful. However, it is important for professors to place students in peer review groups in which they will not feel like “the only one.” For me, that meant being in groups of women. Engineering institutions, on the other hand, have the duty of actively altering course requirements to emphasize the importance of ethics and prioritize inclusion. To increase the number of marginalized students in engineering and retention, professors and institutions must be open to an emphasis on justice and inclusion in their engineering courses. Truly caring about students of marginalized identities means that there will need to be changes in the way courses are taught and in the values academic institutions acknowledge.

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Appendix

Appendix A: Code Descriptions

Definition and Usage of portfolios: The way students define what a portfolio is, to whom it is tailor towards, and what information is included

- A student may create their portfolio using a website builder or PowerPoint slides
- A student may design their portfolio to use for job applications or for graduate school applications
- A student may include only project they worked in classes or engineering projects alongside artwork they have completed

Definition of engineering: Skills, knowledge, or values that students believe makeup the field of engineering

- A student may choose to describe engineering as an intersection of math and science or an avenue for building and designing
- Alternatively, a student may identify skills or knowledge they believe are unique to engineers

Employers defining engineering: Skills, knowledge, or values that employers believe makeup the field of engineering from a students' perspective

- A student may believe that employers see engineering as a method of maximizing production

- A student may also include phrasing in their portfolio descriptions that are tailored towards their belief of what employers define as engineering

Pathway for Racism to flow: Engineering being used to further oppress marginalized communities through design, directly or indirectly

- Real-world examples: Engineering was used to design and build a mechanism that would be used by enslaved people to increase production of cotton, therefore increase the “need” for enslaved people and resulting in further exploitation
- Exclusivity: Dismissing non-Western populations for not practicing Western engineering practices

Engineering consumerism: Industry using engineering to maximize profit disregarding environmental impacts

- Employers may use language like “increase production” to describe a goal they want engineers to achieve

Resource Consciousness: FGLI students note the limitations their socioeconomic status creates

- A student may note that they avoided working on a project because of the monetary strain it would cause
- A student may compare their project to that of another student whose materials were more expensive
- A student may describe experiences in which they became hyperaware of the material things they possessed

Funds of Knowledge: The knowledge and skills that have been historically and socially collected by students typically for the well-being of their household

- A student learned how to make concrete forms from working with their dad over summer
- A student gained knowledge on fluids by helping their uncle route a pipe from the river to their farm

Guilt: A student questioning or regretting a choice they have made

- A student may experience emotional turmoil for removing a project in their portfolio

Imposter Syndrome: Students feeling like they do not belong in a space due to their self-perception. These spaces have grown a standard behavior or mentality that is not embodied by all students

- A female student becomes an undergraduate researcher in an all-male lab and questions her belonging
- A first-generation student graduating with a 4.0 GPA but feeling like they may have just “gotten lucky” instead of attributing their accomplishment to effort

Comparison to peers: Marginalized students comparing their work to that of a White and wealthy male student, causing emotional distress

- A low-income student may compare their robotic arm design made of scrap wood with a peer whose project was a kit purchased from a website