Inequalities in Science, Technology, Engineering and Mathematics for First-Generation College Women Compared to Their Female Continuing-Generation Counterparts

By

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ABSTRACT. There is an unnoticed body of students present on college campuses across America, first-generation college students. A first-generation college student is someone whose parents or guardians have not obtained a Bachelor's degree. Not only are these students often unrecognized, but their experiences and trials navigating through college are different and often unpublicized. These students face countless burdens during their time in college such as familial pressures, potential financial disadvantages, and lack of parental guidance navigating through college. In this study, we examine the differences in experiences between female, first-generation college students in science, technology, engineering, and mathematics compared to their female, continuing-generation college student counterparts.

The experiences of first-generation female students in STEM depict trials, such as parental pressures and financial burdens, when compared to their female continuing-generation student counterparts. Our own findings, in addition to outside research, support our hypothesis that first-generation college students struggle to adjust to unforeseen college challenges. Our first-generation college student subject asserts that this is largely due to the lack of parental higher education attainment, which intensifies the pressure to ignite an upward social mobility trend for her family.

This study illustrates problematic and impairing issues that first-generation college students may encounter during their time as students, specifically in the field of STEM. College campuses, professors, faculty, and staff must aid this specific body of students to help create a more leveled academic experience and opportunistic future.

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[2] This study was completed by Sose Grum and Taylor Czasnojc. Although there were some components of the study that were completed individually, most of the research was completed as a collaborative effort with much revision and discussion. For data curation, Taylor and Sose both interviewed a respondent, one that was a continuing college student and one that was not. We thank Dr. Molly King, Dr. Laura Nichols, Dr. Cara Chiaraluce and Dr. Di for their extensive aid and support.

INTRODUCTION

As one enters the field of higher education, there are many types of individuals with various backgrounds that often go unnoticed. It is not uncommon for students on campuses to look at each other and automatically assume that they all come from pretty similar backgrounds in order to be at the same institution at the same time. Patton O. Garriott and Stephanie Nisle challenge this notion of thinking in “Stress, Coping, and Perceived Academic Goal Progress in First-Generation College Students.” In this article, the authors state, “27% of graduating high school seniors and one in every six students on a university campus is a first-generation college student” (2017:436). Although a significant rating, the presence of first-generation college students on campuses is not an aspect that is highlighted nor commonly acknowledged. For college graduates today, only 32% of the degrees in the disciplines of science, technology, engineering, and technology are received by women. Furthermore, “Early Experiences and Integration in the Persistence of First-Generation College Students in STEM and Non-STEM Majors” by Dika and D’Amico, states that “In 2014, women’s share of undergraduate science and engineering degrees was less than 20% for engineering, [and] less than 40% for earth and physical sciences” (2016:369). An even smaller percentage of the science, technology, engineering, and math (STEM) fields award degrees to first-generation college females. Specifically, even though first-generation females are equally as motivated as their continuing-generation counterparts, they are less likely to finish or obtain a degree in the STEM fields (Carter 2017). This could be due to the additional adversities that first-generation students have to overcome, such as lack of parental experience with higher education, which makes them less likely to accomplish this goal.

In this study, we examine how the experiences of first-generation female STEM college students differ when compared to their continuing-generation female STEM college student counterparts based off of their familial education status. We argue that first-generation female college students who are in the STEM fields tend to find themselves dealing with more adversity and familial pressure to be in those fields when compared to their counterparts. The first-generation students’ inherent minimal financial stability and college experience knowledge from their familial resources perpetuates this belief. First, we will discuss our methods for our interviews as well as our strategy for our codings. Next, we will consider our results and how it connects to our argument. Finally, we will talk about what generalizations can be made about our research.

LITERATURE REVIEW

Role Models and Educational Attainment

One drawback for first-generation students entering the fields of STEM is the absence of role models in their lives who are a part of the STEM fields. A study conducted by Michael J. Fernandez, Julie Martin Trenor, Katherine S. Zerda, and Cassandra Cortes focused on barriers for first generation students in the field of Engineering. The

researchers claimed that only three out of the eight students studied had a role model in the engineering field when they were growing up. One of the students even stated that he did not even understand what an engineering degree entailed until a university representative came to his high school (Fernandez et al. 2008). As a result, it is difficult for these students to picture a reality of obtaining a degree that is highly regarded in society, considering the normalized educational trends for this underrepresented group. First-generation students feel a disadvantage to major in STEM because of the lack of parental understanding. Unfortunately, this sparks a conflict between school and family obligations.

Familial Pressures and Guilt

A very common obstacle that first generation college students face while working towards a degree is studying what they intend to rather than what their parents desire. Many first generation college students feel guilty attempting to study what they would like to due to the fact that they are aware of the immense amount of sacrifices their parents are making to send them to college. In “Potential Family and Mental Health Considerations for Working with First Generation College Students Exploring Careers” Melissa Wheeler (2016) illuminates the idea that first generation college students feel an immense amount of pressure and guilt to pursue their own dreams. As a result, this can place a student in great conflict with themselves, making it difficult for them to obtain a higher-education (Wheeler 2016). In addition to this, first generation college students feel an immense amount of guilt as they are expected to help their families financially, hence a main reasoning behind why they feel a need to attend college (Bui 2002). It is uncommon that first-generation college students are awarded the opportunity to attend college without facing pressures and guilt, due to the lack of college attainment their parents or guardians had.

Lower Socioeconomic Status and Stressors

An important drawback for many first generation college students that is overlooked by academic institutions and their familial members is the financial stress they may obtain from being in college. There are many considerable reasons for what the indicators may be for their financial stressors, but often the financial stress they feel stems from the reasoning that they do not have financial support from their familial members. Even if they were to receive financial support from their familial members, it would not be enough of a consistent safety net to reassure them during their time in college. Due to this, there is additional pressure in their field of study to provide financial stability not only for themselves, but for their families as well. In a study completed by Anthony P. Carnevale and Nicole Smith (2018), the authors depict that Black individuals and first-generation college students are often disproportionately impacted financially. They not only tend to come from low-income backgrounds, but also have to work while in school. This is not only to take care of themselves, but of their families as well.

There are many studies that focus on the underpopulation of first-generation students in STEM, as well as the underrepresentation of women in STEM. Overwhelmingly, these studies conclude that it is difficult for these underrepresented populations to combat the norm that STEM fields primarily consist of white, well-educated men. There seems to be a lack of research that studies this particular intersectionality of parental educational status and gender, so we decided to explore this occurrence further. Our research is unique in that it seeks to explore the differing experiences of women in STEM at Santa Clara University based off of their varying levels of familial exposure to higher education. Our subjects support these claims that the experiences between women who are first-generation students and continuing-generation students are different because first-generation students face more familial obligation to enter the STEM fields.

METHODS

For the methods of our research, we collectively conducted two interviews. Our research population consisted of first and continuing college women majoring in the STEM fields at Santa Clara University. One of the students we interviewed is a black female who is in her fourth year at Santa Clara University, while the other female respondent is a white student who is in her second year. Both respondents happened to be Biology majors. In addition, both of our interviews were carried out in the basement of the dining hall on campus in an area called the Benson Memorial Center. This is located near the on-campus convenience store, The Cellar Market. We sat with each of our interviewees in light-green, comfortable sofa-like chairs, slightly isolated from other students present at the time. Although slightly isolated, we were close enough to see other students and staff walk by. We believed the proximity to other students and staff just lingering by would help the respondents feel more comfortable during the interviews. Each interview lasted around 45 minutes on weekdays between classes.

When selecting our subjects for our study, we used a combination of convenience and purposive sampling. We utilized our personal networks to gain access to our research population and our own judgement when reaching out to people to participate in our research. For example, our first-generation student was selected to help us gather our data because of our team's personal connections to the university's LEAD program. LEAD is a program available on the Santa Clara University campus to support and guide first-generation college students who are looking to maximize their opportunities during their four years as a Bronco. When selecting our continuing-generation subject, we also utilized our personal networks because of knowledge of this particular subject's experience in STEM through interactions outside of a research setting. When trying to establish rapport and field relationships, our main strategy was to establish a non-threatening demeanor with our subjects. As Lofland and colleagues state in their "Getting Along with Members" section, "in most qualitative research situations, the investigator who is supportive, cordial, interested, non-argumentative, courteous, understanding, and even sympathetic will receive a good deal more information than one who acts in the opposite fashion" (Lofland et al. 2006: 68-69). We used this method to help our subjects feel more comfortable with sharing meaningful experiences with us.

As a result, this produced relevant, insightful data for our research. We attempted to take great precaution during the interviews so we would not impact the answers of the respondents in any way. We wanted to obtain the most authentic forms of responses. This method helped to encourage routine activity that is typically carried out in the applicable settings.

When approaching our coding for the interviews, we focused on the primary influences on our subjects' motivation to study within the STEM field. These codes revolved around the theme of familial exposure to higher education. Some of our codes for our interviews include, "familial factors," "school," and "perceptions." This was a finding we did not anticipate but we were able to understand that this could potentially be very important to our overall analysis.
Although we could have used various other codes for our interviews, we chose these codes because they are applicable to specific and broader interview observations. Our variety of codes also comes from an open-minded strategy we used in our coding. In *Writing Ethnographic Field Notes*, the authors explain:

> In such line-by-line coding, the ethnographer entertains all analytic possibilities; she attempts to capture as many ideas and themes as time allows but always stays close to what has been written down in the field note. She does so without regard for how or whether ideas and categories will ultimately be used, whether other relevant observations have been made, or how they will fit together. (Emerson et al. 2011: 175)

This supports our reasoning for our approach in our interview coding. When considering what open codes to use, we focused on prevalent themes, regardless of whether or not they seemed relevant to our research topic at the time. Eventually, this strategy helped us narrow down what codes were more important than others for our study.

We did not encounter any ethical dilemmas as we had created a consent form for our interviewees and went over key logistics with them. They were told that they could opt out at any time, that we would not disclose their names, and that they had complete and total control of what they wanted to share with us and what they would like us to write down, or not. We let the respondents know that they were entering a safe space and that there was no intended manipulation that was to be done. The respondents believed and trusted this, thus providing us with answers that seemed to be vulnerable and dedicated. In addition, due to the previous familiarity the respondents had with us, there was already some rapport established as we were not complete strangers to them.

RESULTS

Some main takeaways we noticed from this study is that as our thesis confirmed, first-generation college students, in particular women in the STEM fields, may face more adversity and familial pressure when compared to their non-first-generation female counterparts in STEM. They also are forced to make certain decisions based on their potential minimal financial security, which was an experience our first-generation subject resonated with. In addition to this, they are forced to make decisions based off of minimal, if any, college experience knowledge from their familial resources. In "Challenging the Model Minority Myth as a First-Generation College Student," Huynh

describes this similar notion as he states, “First-generation students of color often navigate the college experience with families who have little to no context surrounding higher education, may have varying levels of college readiness upon entry, and frequently encounter financial challenges” (2019:123). In support, our first-generation college respondent consistently touched on her personal adversities and familial pressures as a first-generation STEM major. She states:

> I think because [my parents] didn’t have exposure to college, they were unable to prepare me for the millions of things I wish I had known before I started college, stuff that I know my peers have known like small things...like making sure to buy flip-flops for your shower. I know that’s something that some people would be like duh about, but that’s such a small example.

We were also able to see that for our respondent, there was much more familial pressure and determination to obtain financial stability in the near future for the first-generation college student in deciding her major than we had anticipated. When asked about deciding her major and the reasons why, the same respondent answered with:

> They [my family] would never be okay with me majoring in like [pause] art. That would not be possible. Or even something like business, I was interested in business when I was in high school. My uncle kind of discouraged it… [my parents] didn’t have options when they came. Their options were STEM because they couldn’t speak English, you know? That’s really ingrained in them and I believe that I see that, you know? So, I think they think that’s the same reality for us even though it’s not true.

Our respondent makes it clear that due to the differing backgrounds of her familial members, she has had to make impactful decisions on her personal life. The respondent touched on the financial stability she hopes to one day obtain through the STEM field due to the responsibilities she knows she will face of taking care of her immediate and extended family members. In her interview she states:

> There’s like a lot of different [reasons] as to why I needed to go to college. But like I think the first thing that comes to mind is like financial stability in terms of my future, in terms of like my family, not just myself. I’ve always equated college to money, like earning more money. I think because obviously my parents are lucky enough to have money...but it’s not something like generational wealth which is something I can kind of lean back on, this is just kind of like a temporary thing, you know what I mean? … I’m here to support my entire family. That it is not just my mom, dad and my brothers, but my cousins, grandparents and my family back home.

Huynh describes the commonality between our respondent and other first-generation college students relating to familial pressure and wanting to create financial stability as he states, “Some first-generation college students express feeling a sense of responsibility to help their families once they finish college, and some express guilt about pursuing a college degree while their families are struggling to survive financially” (2019:126).

Moreover, we encountered a psychology study (Wang et al. 2017) that examined what factors influence a STEM female student’s transfer intent from a two-year institution. Similar to our research, one contributing factor was that being a first-generation student was a deterrent for a female’s ability to transfer. It was stated that, “first-generation college women may not receive a reaffirming opinion from their parents about the

benefits of a postsecondary credential, in that their parents are not able to be role models, or do not have the knowledge and experience of postsecondary education, to encourage their offspring to pursue a postsecondary degree in STEM" (Wang et al. 2017:3). We see how this argument is enhanced with our own findings, especially with our first-generation subject.

For our continuing-generation college student subject, her interview data uncovers a different type of pressure she feels in regards to her studies. However, it does not compare to the multiple other pressures our first-generation STEM female student encounters. Our continuing-generation subject discloses:

> Both of my parents went to law school. So, maybe there's a bit of an expectation to do a more professional career. But I would just say, that having parents that were/are very motivated and like the 'whole nine yards' makes me feel motivated to need to stick to it too, but then also, it's helpful because they might understand how crazy it is and stressful. So, I would say it motivates me… obviously they have expectations for me, so I want to live up to them. It doesn't really matter what I do, they just want me to do my best [laughter].

Our continuing-generation subject faces pressure to meet, if not exceed, her family's expectations of a professional career. She discloses to us, however, that it also helps her in reaching her career goals, because her parents can provide support and empathize with the kind of work it entails to receive a higher-education degree. Her parents can provide insight into a situation of the unknown. This element can provide a sense of comfort on top of all the other undiscovered, nerve-racking parts of the college experience, which can often be taken for granted.

As previously mentioned, our continuing education respondent felt pressure to attend college because it was an expectation set in place by her parents, who had previously attended college before her. The US Department of Education finds that, "College enrollment rates vary considerably with parents' educational attainment. In 1999, 82% of students whose parents held a bachelor's degree or higher enrolled in college immediately after finishing high school" (Choy 2001:3). Our continuing-generation student states in her interview that one of the primary motivators for her to go to college comes from the normalization of it from socializing agents, particularly her peers. When asking our interviewee "the push" to go to college she states: **"**I'm not really sure there was even a push, but I went to like a college preparatory high school. So only like six kids from our class of 300 didn't go to college. So, I think that was what was expected of you." The normalization of going to college not only exemplifies the lack of pressure from her family, but also from other sources in her socializing environment. There was never a question that she would not attend college or pursue whatever career she aspired to do because of her financial stability and family's previous history of attending college.

CONCLUSIONS/DISCUSSION

Our research study enforced an understanding that different levels of parental educational attainment have an influence on multiple factors of a first-generation college student's experience. As we looked at women within the STEM field, we were able to

see that there was a direct impact on major selection due to varying levels of parental educational attainment. While there is an understanding that college should be a place of learning by one's free will, our literature review and original research finds that many female, first generation college students in the STEM fields could potentially be enrolled in higher education by the pressures of outside forces such as family. We assert the reasons behind this would be to potentially create financial stability that had not been seen in their family before and could last for generations to come. From this study, we believe that first-generation college students face incredible adversities and trials when entering higher-education. These adversities and trials include less familial support for what the students themselves want to study, pressures to take care of individuals who will be reliant on their financial support, familial pressures of choosing a STEM major for potential financial security, and a lack of support and guidance from familial members in terms of basic college navigation skills. These adversities usually stem from the lack of college attainment by parents, leading to a lack of financial security. Due to the lack of financial security, the pressure is placed on first-generation college students to create a sense of security in their own lives and the lives of their family members. In addition, since the parents of first-generation college students did not attend college, they cannot rely on them for information about basic college navigation skills. Due to this, there is an added pressure on students to figure out how to get through the college experience by themselves.

Based on our findings, we came to the understanding that continuing-generation students may not feel a similar pressure to maintain a major in order to provide financial support to their immediate and extended family. Furthermore, we found that the college experience for continuing-generation students may not be as difficult because their parents went to college and are able to guide their children through many realms of the college experience.

It would be essential for future studies to be able to look at first-generation college students and the fields they ended up in after college and using that data to look at outcomes such as satisfaction and happiness in their lives. It would also be essential that future studies focus on why first-generation students must carry the burdens of their families, as in why is there a lack of resources to aid those who did not go to college. Lastly, it would be possible to use this idea in future studies to look at the disparities in the lives of the children of those who went to college compared to those who chose not to or were unable to.

We would like to acknowledge the limitations of our research, as our sample only consists of two subjects. The data presented cannot be generalized to the experiences of all female first-generation and continuing-generation college students within STEM at Santa Clara University. Our findings also cannot be generalized to larger populations of first-generation female college students within the STEM field. We claim that a significant portion of these populations can relate to the experiences being presented in our findings because of shared variables that result in similar, pronounced effects.

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