Who are we? Beyond Monolithic Perspectives of Latinxs in Engineering

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Latinxs, a gender-inclusive term used to describe people in the United States of Latin American descent, are the largest ethnic group in the United States (U.S.). Its percentage of representation in the U.S. population is projected to increase to 29% by 2050 (Passel & Cohn, 2008). In engineering, Latinxs continue to be underrepresented and while interventions and programmatic efforts have helped to increase the number of Latinx engineers in the United States, the increase of this population in the United States is not proportionate with the current representation of Latinxs in the field. Many research papers have been published on the efforts to address recruitment and retention of Latinx students in engineering, yet there still remains a lack of understanding about the status of Latinx students in engineering across the educational pathways, and about the heterogeneity in this population. The purpose of this work-in-progress literature review is to explore, critique, and synthesize previous research studies that investigate the Latinx experience in engineering. The literature review is guided by the following two research questions: How is the diversity within Latinx described in the engineering education literature? How is the engineering educational pathways for Latinxs described in engineering education literature?

The objectives of this review are: (1) to describe the current state of engineering education for Latinxs; (2) to discuss how the diversity that exists within this group has been studied; and (3) to draw conclusions based on this information to describe the underrepresentation of Latinxs in engineering and why it continues to exist.

Methods

The databases ERIC and Google Scholar were used to locate preliminary sources. Combinations of the following search terms were used: “Latinas/os/xs,” “Hispanic,” “engineering,” and

"STEM." Several articles were identified as potential sources of information, but only journal articles that met the following inclusion criteria were considered: (a) published after the year 2005; (b) population of interest included Latinxs; (c) focused on engineering or included engineering within the larger STEM literature; and (d) studied K-20 education. These articles were not limited to journals in engineering education research; these articles were published in journals such as in higher education, science education, and counseling psychology.

After the journal articles were selected, these were divided into three categories: (a) *pre-college* including K-12 educational environments; (b) *college* including two- and four-year institutions; and (c) *post-college* including graduate school and higher. Journal articles were divided among the authors for the first round of review. Each article was reviewed in detail by at least one author, who took notes using the agreed-upon code sheet, the lead author reviewed the notes for all of the journal articles included in this literature review. In total, there were 36 papers that were reviewed: 5 in pre-college, 25 in college, and 6 in post-college.

A code sheet was developed using the categories necessary to answer the two research questions. The categories for the code sheet were ethnicity, race, gender, language(s), generation in the U.S., generation in college, and institution (college-only). When reviewing each article, the authors noted how each category was used for the purpose of data analysis. Additionally, in the review of each article, the authors also noted the main conclusions of each study as these related to the status of Latinxs in engineering. After reviewing the majority of the assigned articles, the authors met to review the preliminary findings and patterns they saw in their respective notes. The lead author noted these and used these as guidance for the final review of all 36 articles.

Limitations

This work-in-progress literature review is limited in a few ways that we will fully address in the full iteration of this review. One limitation was that more articles may have been included in our review if additional relevant databases such as Education Full Text (EBSCO), JSTOR, and Scopus were considered. We opted to exclude conference proceedings in this work-in-progress paper. However, full empirical conference papers that meet the inclusion criteria will be included in the full iteration of this review. To expand upon the way we analyzed the heterogeneity in the Latinx population, we could add other demographics and characteristics such as religion, sexuality, and social economic status; we intend to do so in the full iteration of the review.

Results

The results from this work-in-progress literature review are organized below by research question. Although not all of the reviewed articles are directly referenced in this section, they are all included in the References section of this paper. Note that we used the terms Latinxs, Latina/o, and Hispanic throughout this section to reflect the terminology used in the papers reviewed.

Diversity in Latinx

The first research question we addressed was "How is the diversity within Latinx described in the engineering education literature?" While our literature search yielded thirty-six journal articles, less than half of the journal articles focused solely on Latinx students. The remaining articles focused either on traditionally underrepresented students (i.e. African American, Native American, and Latina/o students) as a group or on Hispanic Serving Institutions (HSI). There were six demographic categories (i.e., gender, race, ethnicity, language(s), generation in the U.S., and generation in college) that we looked for in each journal

article. Though these demographic categories do not make up a complete list, they begin to illuminate upon the diversity within the Latinx population. The "generation in college" category was included because the primary population of interest in this literature review were students or persons who have been through the engineering educational system (e.g., engineering faculty, engineering professionals).

The majority of the articles reviewed analyzed the gender differences among Latinxs. As depicted in Figure 1, twenty out of thirty-six of the studies, either investigated gender differences or focused solely on the experiences of females. The pre-college experiences of high-achieving Hispanic female science or engineering students include better college preparation and participation in academic enrichment programs when compared to Hispanic males (Brown, 2008). Hispanic women at Hispanic Serving Institutions were found to be less likely to declare a STEM major (Crisp, Nora, & Taggart, 2009). There are gender differences in the engineering majors that men and women select where Latinx men are more likely to matriculate in Electrical Engineering than Latinx women (Lord, Layton, & Ohland, 2011). Compared to African-American, Asian, and White women, Hispanic women are the most underrepresented in engineering; however, they persist at the same rate as Hispanic men in engineering (Lord et al., 2009). While investigation of gender differences was prevalent in these studies, gender was used as a dichotomous variable for analysis in most of these studies.

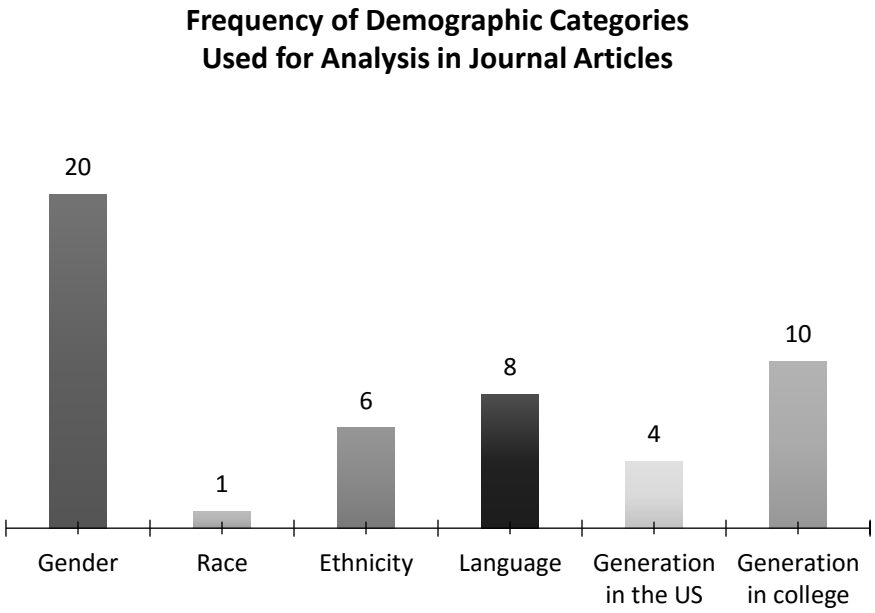

Figure 1: Frequency of Demographic Markers Used for the 36 Analyzed Articles

A detailed description of a participant's ethnicity was discussed in only six articles. Overall, the majority of studies did not describe the term used to identify the Latinx population of the study. The following terms were used in the studies reviewed: Chicana/o, Hispanic, Latina/o, Mexican, and Mexican American. Studies noted that the sampled population "self-identified." While most articles reported that students self-identified as Chicana/o, Latina/o, Hispanic, Mexican American and/or Mexican, they did not investigate the differences among the various ethnicities within the larger Latinx population. Researchers have shown that there are educational differences among ethnic groups within the Latinx population in the United States (Sólorzano, Villalpando, & Oseguera, 2005).

In all papers but one, the study of race was either combined with ethnicity or not discussed. In other words, the vast majority of papers did not use race separately to guide data analysis. Researchers have shown that there are nuanced differences among Latinxs based on

phenotype; in particular, research has shown that there are benefits for Latinas/os who can pass as White (Johnson, 1997).

Ten articles investigated the differences among students with regards to generation in college. In most instances, researchers looked at the highest level of a parent's education. For students at HSIs, the decision to major in STEM is influenced by the parent's level of education (Crisp, Nora, & Taggart, 2009b). Yet, regardless of a parent's level of education, they are a key source of encouragement to persist and achieve in education for Latinx students (Peralta, Caspary, & Boothe, 2013).

Only eight out of thirty-six articles studied language as a variable to further understand the diversity in experiences within the Latina/o population. Most of these studies, focused on the experiences of English Language Learner students.

A minority of articles, four out of thirty-six, purposefully used generation in the United States as a variable to understand the nuanced experience of Latinx students. The importance of incorporating variables such as immigration status has been highlighted by Latino Critical Race Theory researchers (Solórzano & Bernal, 2001). Accounting for immigration status for students in STEM may help with understanding how these students resist oppressive cultures within these fields (Peralta et al., 2013).

Latinx Engineering Educational Pathways

The second research question addressed by this literature review was "How is the engineering educational pathways for Latinxs described in the engineering education literature?" There were only five articles that investigated the pathways to college for middle school and high school students. Only one of these articles (Wilson-Lopez, Mejia, Hasbún, & Kasun, 2016) focused on Latina/o students. To ascertain STEM-readiness, researchers (Andersen & Ward,

2014; Aschbacher, Li, & Roth, 2010; Zheng, Warschauer, Hwang, & Collins, 2014) investigated identification with science in high-achieving and low-achieving or "at risk" students. Community college is a critical pathway to engineering for Latinx students. Yet, twenty articles reviewed were studies about students attending 4-year institutions, and the majority of these did not specifically focus on transfer students.

Perhaps unsurprisingly, there is a pattern of interventions, programs, and services that are described as beneficial or necessary for the retention of Latinx students in college. These include mentoring, the involvement of family, peer support, and positive faculty support. Villareal, Cabrera, and Friedirch (2012) assert that hiring of Latina/o faculty and administration at various levels is a key factor to ensure the success of Latinx students in STEM. Similar results are found for Latinx graduate students. Latina graduate students reported having positive attitude, self-confidence, and time-management, yet they felt isolated in their programs and felt a lack of support from faculty advisors (Aguirre-Covarrubias, Arellano, & Espinoza, 2015). However, none of these publications expanded upon the systemic challenges of implementing these interventions, the need for more holistic approaches for these services, and the underlying reasons for isolation and perceived lack of support.

Discussion

With regards to our first research question, we found that the majority of these studies were not nuanced by culture, language, immigration status, and other factors that may better help researchers/educators understand Latinxs in engineering. As found in critical theories, histories, cultures, and experiences are important considerations to remove traditional power dynamics and systemic factors that marginalize underrepresented groups (Mejia, Revelo, & Villanueva, 2017). As future researchers move into research about Latinxs in engineering, careful and purposeful

selection of participants and institutions are needed to ensure that interventions stemming from researcher findings yield more meaningful results in practice. In many ways, aggregating the Latinx student experience can dangerously generalize Latinx students' experiences. Findings that are based on these "generalized" experiences can inadvertently pose a greater risk of reenacting exclusionary practices and approaches by educators and decision-makers. This is similar to issues found in accommodation practices for disabled students (Harvey-Carter, 2008). If we are to diversify the current homogenous population of engineering student learners (NSF, 2015), we must consider the individual approaches to ensure success of *all* students in engineering.

Referring to our second research question, across the K-20 engineering education literature of Latinx students, we find that there is an overall agglomeration of experiences and demarcating factors presented as potential reasons for these students' persistence or attrition in these fields. We found that this research primarily focused on students' factors, instead of institutional factors, that can affect retention and persistence of Latinxs in engineering. Research focused on institutional factors may better and more purposefully drive institutional policy for systemic change.

Preliminary Conclusion & Future Work

In this work-in-progress literature review, we found that while there is a wealth of research on broadening participation and improving the retention of traditionally underrepresented students in engineering, the majority of articles reviewed did not attempt to isolate the unique experiences and backgrounds of Latinxs. Furthermore, there is a dearth of literature on understanding *within* group differences among Latinxs. Our future work includes expanding on the literature review by incorporating additional databases. To have a more nuanced understanding of the underrepresentation of Latinxs in engineering, future research must

also consider demographic markers that highlight the diversity within this group. Only then will research be able to clearly inform purposeful and directed practice to address underrepresentation at a systemic level.

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