RIEF: Mapping the Development of Leadership Skills for Undergraduate Engineering Students in Leadership Positions

Prof. Carmen M. Lilley, University of Illinois at Chicago

Dr. Lilley's research interests in engineering education focus on professional development of engineering students at the undergraduate and graduate level. In particular, she is interested in the nuances of how the intersection of race/ethnicity with gender affects professional development in the area of leadership and the long term career trajectory of an individual. Her other research interests are focused on syntheses of low dimensions materials and the characterization and modeling of their material properties.

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Motivation

There is a strong economic argument to increase racial and gender diversity of executive leadership in companies. Researchers found that greater ethnic/cultural and gender diversity of executive leadership teams correlated to financial outperforming other companies by 33% and 21% respectively [1]. In addition, leadership skills are considered as key for those entering the workforce [2]. In general, leadership formation has been widely studied for undergraduate students. There is also a strong body of research on the effects of race/ethnicity and gender on professional development of engineering students in science and engineering, e.g. experiences with leadership for students of color [3], African American men (Sutton & Terrell, 1997), and leadership experiences for women students in leadership roles in colleges [4]. Finally, there have been some studies that explore effects of race/ethnicity and gender on leadership experiences [5]. However, the majority of research focuses on analysis that uses only the lens of gender or race. Yet, the theory of intersectionality strongly supports the argument that the intersection of race and gender results in significant differences in the experiences of individuals and overlooks nuances in factors that influence the resilience of an engineering student.

This significant gap in knowledge on the intersectionality of race and gender on leadership formation of undergraduate engineering students negatively impacts the long-term retention and promotion of Underrepresented Minority (URM) engineers once they enter the workforce. This research aims to address the gap of knowledge on organizational leadership formation by researching the following questions: What are the leadership experiences of undergraduate engineering students? What factors impact act as stressors that may negatively impact their resilience or perseverance to be leaders?

Theoretical Framework

The theoretical framework was to use intersectionality of critical race theory [6-9], specifically using the intersection of race/ethnicity and gender to study the interactions between these two factors on the experiences for URM undergraduates; and therefore mapping the factors for an individual that affect perseverance in pursuing leadership roles. In addition, the outcomes of this research will inform what types of new educational programs or institutional transformation programs can result in an inclusive approach to leadership formation of a diverse undergraduate student population in engineering.

Methods

This research was conducted using a constructivism paradigm and Grounded Theory using Charmaz's approach of the constant comparative method [10]. One-on-one interviews were conducted by the PI with undergraduate engineering students within social subgroups (URM Men, URM Women, Asian Men, Asian Women, White Men and White Women). Questions for the interview guide were developed in consultation with two social scientists with expertise on race and gender; as well as consulting two URM undergraduate engineering students, one male and one

female, who were leaders in their engineering societies and who did not take part in the study. The coding of the interviews was done by the principal investigator. The first transcript was coded by the principal investigator and the social scientists were in consensus with the initial codes. Using a Grounded Theory approach [10], the interviews were coded line-by-line using gerunds and the constant comparative method was used to develop a codebook during the focused coding phase [10]. From the focused coding, constructs, i.e. categories, of the social identities of the students as well as their factors that influenced their personal experiences where defined. Analytical memos were also being concurrently maintained during the coding processes. Axial coding was done after the initially focused coding was completed for all of the themes discussed in the interviews. From this analytical approach, a concept map of the factors that act as stressors in organizational leadership experiences for undergraduate engineering students are proposed and the interactions among social identities and other factors are discussed.

Results and Discussion

The categories that emerged from this research are compared to the leadership development model by Knight and Novoselich [11]. The findings of this work also indicate that there are personal traits that act as inputs to the development of social identities, affecting access to available resources before and during a student's education. Some of the emerging themes indicate that pre-college variables affect how students may interact with the institutional engineering education environment. Three social identities emerged as the most significant identities of the students in this study: gender identity, race/ethnicity, and sexual identity. Women were conscious of being "women in engineering" and alluded to negative experiences with sexism, of which there were stereotypes based on the "double bind" of being a woman of color in engineering and leadership [12]. Finally, being unable to be authentic was also prevalent among the students of color in this study. For example, a Latina woman discussed how she tailored her behavior when performing her leadership duties: "The way I converse, definitely a male thing. Because I definitely talk a little bit differently when I'm with family and people I know very well." Thus, failing to include racialized and gendered experiences may overlook factors that can act as stressors on the leadership experiences and development of engineering students.

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