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The Relations of Ethnicity to Female Engineering Students' Educational Experiences and College Career Plans in an Ethnically Diverse Learning Environment

Our interdisciplinary research team was motivated by a desire to contribute to national efforts to increase the diversity of students studying engineering, and ultimately, entering the engineering workforce. The ethnically, culturally, and socioeconomically diverse student population at the University of Houston was a logical research setting to help advance knowledge about under-represented students' experiences in undergraduate engineering studies. We started this project with the expectation that students from different ethnic groups may perceive varying supports and barriers for their engineering college and career plans.

Our work builds on that of other researchers in the social sciences, such as Seymour and Hewitt (1997), Lent and colleagues (1994, 2000), Phinney, Dennis and Osorio (2006), and Pascarella (2006). Seymour and Hewitt's seminal work identified four unique factors contributing the attrition of students of color in science, engineering and math: 1) differences in ethnic values and socialization, 2) internalization of stereotypes, 3) ethnic isolation and perceptions of racism, and 4) inadequate support systems. Lent and coworkers (2005) investigated the experiences of African American students studying engineering at predominately White institutions (PWIs) and historically Black colleges and universities (HBCUs), finding that African American students at HBCUs perceived higher levels of support and decreased barriers compared to those at PWIs. We knew that the learning environment for students at UH was distinct from either a PWI or an HBCU, because no one ethnic group constituted a majority, and we set out to study our students to provide additional insights about salient factors important for recruitment and retention of diverse students in engineering. The lead author's position at the time of the study as the director of the UH women-in-engineering program as well as her experience in undergraduate engineering recruitment and retention led us to narrow our focus to female engineering students for this exploratory study.

We investigated three research questions:

1. How is ethnicity related to female students' perceptions and experiences related to engineering?

2. How do these factors influence female students' selection of and intentions to persist in engineering majors?

3. What are the experiences of female engineering students of color in an ethnically diverse learning environment?

We adopted the theoretical framework of social cognitive career theory (SCCT; Lent and colleagues, 1994; 2000) and utilized a mixed-methods approach for exploring the research questions. Based upon Bandura's (1986) influential social cognitive theory, SCCT has been utilized to understanding individuals' career choices and development, including recent investigations within engineering (e.g., Lent and colleagues, 2003; 2005). According to this framework, an individual's intention to persist in a career or field is influenced by a variety of environmental/contextual and personal factors.

Participants (N = 160) completed an online survey instrument consisting of demographic questions and items adapted from the engineering education, educational psychology and higher education literatures. Constructs explored included social supports, barriers, sense of belonging and experiences, impressions of engineering and persistence goals. While acknowledging that ethnicity is a multi-dimensional concept and there were undoubtedly within-group differences among each ethnic group, we used students' self-identified ethnicity: African American (N = 17), Asian (N = 32), White (N = 54), or Hispanic (N = 48). Using the Statistical Package for Social Sciences (SPSS), we employed ANOVAs to compare the four ethnic groups on the main variables and found no statistically significant ethnic differences (ps > .05) on most variables. The only significant difference was in perceptions of the field of engineering, where Hispanic students had a more positive perception than did Asian students (F(3, 147) = 4.25, p F(2, 153) = 4.15 , p p

We then used qualitative data collected from interviews with 37 survey participants to explain and expand upon results obtained from the quantitative phase of the research. Interviews focused on supports and barriers for college and career plans. The data revealed that students perceived different barriers than we had asked about in the survey. For example, financial worries, balancing school/work/family, commuting, and lack of role models were more pertinent barriers for this sample than survey items such as feeling pressure to change their major. Five major findings emerged from the interviews:

1) Family and school personnel influence on major and career choice differed by ethnicity; specific roles varied with parental education level and occupation.

2) The purpose for pursuing an engineering degree differed by ethnicity.

3) Sense of belonging and social supports existed for participants of all ethnicities.

4) Conflicting role struggles existed for some students of color.

5) Academic preparation acted as a barrier for some students of color.

Some of these results differed from Seymour and Hewitt's study (1997). For example, none of our participants reported instances of negative stereotypes or racism. Instead, our participants were part of diverse peer groups and perceived ample support systems which contributed to a sense of belonging and positive educational experiences for students of all ethnicities. While the reasons for pursuing engineering differed with ethnicity, many perceived differences in supports and barriers were based on generational status in college and socioeconomic factors, not ethnicity *per se.*

From these results, we concluded that when ethnic isolation and minority status are not part of an under-represented students' educational experience, other salient factors such as generational status in college may be an influencing factor in their perceived barriers and supports for their engineering college and career plans. We discuss the implications of these findings for recruitment, retention and pedagogical practices in the "JEE Selects" column of December 2008 issue of *Prism* magazine. Our suggestions in that article included: including secondary school personnel in outreach efforts about engineering college choices, promoting engineering as profession as a vehicle by which underrepresented students can help their community and immediate family, supporting women-in-engineering programs and making financial aid more readily available.

This research has presented many interesting areas for future study. Current projects are further investigating the influence of generational status in college on the educational experiences and academic and career decisions of both male and female students. These include exploring family roles in engineering students' decision making processes, as well as developing engineering outreach and recruitment materials geared towards first generation college students.

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