Diversity in Engineering Education Research:
Insights From Three Study Designs

Authors: Cheryl Allendoerfer, Sharon Jones, Jaime Hernandez, Rebecca Bates, and Robin Adams
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One research area with particular potential for having impact on engineering education is diversity. Diversity is a significant concern in engineering education, as evidenced by the numerous recent calls to recruit and retain more women and underrepresented minorities into engineering majors and professions. By encouraging educators to think about diversity, we hope to emphasize the idea that investigating issues of diversity in engineering education means both characterizing retention and participation in engineering and delving into the theories that might help explain these patterns.

Examples of how people are thinking about and studying diversity can be drawn from the work of engineering faculty who participated in the Institute for Scholarship on Engineering Education (ISEE). The primary goal of ISEE is to cultivate a diverse community of engineering education researchers who can think and work across disciplines with the ultimate aim of improving the engineering student experience.

Because of the context-dependent nature of diversity issues, it is difficult to provide a simple set of guidelines or steps to follow. The information below is intended to be useful to other engineering educators who are interested in studying diversity issues in their own contexts.

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Implications of Findings

The example studies below examine types of diversity that are frequently discussed as national concerns: underrepresented minority students, transfer students, and learning styles. These researchers developed their studies and conceptions of diversity issues in ways salient to their specific campus contexts.

The researchers were also very deliberate and careful in the development of their research questions and study designs. In each study, both the research question and research methods allowed the researcher to first assess the study context, describe the situation, and back up that description with data. The researcher was then well-positioned to dig deeper and develop a richer, more meaningful explanation of why and how certain things were happening in the setting.

The following suggestions may be helpful for those wishing to embark on this type of research:

- Rethink your definition of diversity by asking what other types of diversity might be playing roles in your setting.
- Formulate a research question that goes beyond exploring the "what" and gets to the "why" and "how."
- Consider research methods that can portray the landscape and describe your context, and also dig deeper to understand the experiences of the people involved.

   Additional suggestings stemming from the 2006 ISEE Scholars' experiences include:
- Know your target population. For example, work with a student from the target population early in the study design process to assist with the development of protocols, subject recruitment strategies, etc.
- Become familiar with your institution's Internal Review Board and begin the Human Subject approval process early.
- Read the relevant body of knowledge about the diversity issues on which youare focusing.
- Pilot test interview or survey protocols, if possible.
- Get buy-in from your department, school, and/or institution.

Background and Case Studies Examined
The 2006 ISEE Scholars were selected from a competitive, national pool of candidates based on the strength of each Scholar's application, including a diversity-focused research proposal. Each Scholar came to the ISEE summer workshop with an initial research question, which was revised and refined over the course of the week. Scholars also developed research plans, including appropriate research methods and project timelines.

The suggestions offered above for those wishing to embark on engineering education research are based on the three examples of Scholars' research described below as well as the overall experiences of the entire 2006 Scholar cohort.

Study #1 examined the experiences of African American and Hispanic American students at Lafayette College. Focusing on these students is important and timely in this specific context because of the demographics of this four-year college's student population, the college's current efforts to recruit and retain students from these particular minority groups, and the fact that the college already practices many proven retention strategies, including working with the POSSE Foundation. Scholar #1 investigated the following question: *What effect does an intensive, structured mentoring program (POSSE) have on the retention of first year engineering students from minority backgrounds?* A grounded theory approach with purposeful sampling of the college's Class of 2010 was used to address this question. Quantitative information was collected in order to understand the background and current academic circumstances of the study participants. In addition, a semi-structured survey with a wide range of questions was conducted, making it possible to delve into nuances of the students' educational experiences and enrich the researcher's understanding of what was taking place in the study setting.

Study #2 also examined diversity along racial/ethnic lines, but does so in combination with students' pathways into engineering. It is appropriate to narrow the scope from all minority

students to specifically Hispanic students, because this university's undergraduate student population was 21% Hispanic in 2006 and the state has an explicit interest in addressing the educational needs of Hispanic Americans. Scholar #2 investigated the following question: *What are the most meaningful learning/developmental experiences that motivate Hispanic students to transfer from selected Texas community colleges to a four-year engineering program?* The study design includes a large-scale questionnaire administered to Hispanic American transfer students that was used to gain a broad understanding of the transfer student experience. Next, focus groups were conducted with small groups of students from the target population for guided discussions with the researcher. Information from this study will inform the university's efforts to support these students during their time on campus, and should help improve recruitment and retention efforts as well.

Study #3 examined a different type of diversity. In this study, student diversity is defined as differences in learning styles which may or may not be addressed in a typical college classroom. Scholar #3 investigated the following questions: *What are the relationships between learning styles and clustered major groups, gender, and length of time in college?* and *In order to debrief students and make knowledge of their learning style useful for them, what information about learning styoles will be most useful for (and read by) participants?* This study design includes a survey that incorporates the Felder Learning Style Inventory, as well as basic demographic questions. The results of the survey will be used to get an agglomerative measure of the learning style distributions that can be compared across different demographic factors. In addition, focus groups and individual interviews targeting upper-division students were conducted, so that their experience with learning can be used for reflection. Studying the diversity of learning styles may be useful for individual students and their learning, and may be useful for improving teaching styles at this location.

The three studies described above provide examples of how some researchers are conceptualizing and investigating diversity in engineering education. For other engineering educators who may wish to conduct similar studies of diversity issues, it is important to view these examples not necessarily as models to be replicated, but as illustrations of the importance of context and the critical need to rethink assumptions about diversity.

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