Selected Publications

Butterfield, A. E., McCormick, A., & Farrell, S. (2018). Building LGBTQ-inclusive chemical engineering classrooms and departments. *Chemical Engineering Education, 52*(2), 107-113.

> Abstract - Despite recent advances in LGBTQ+ (lesbian, gay, bisexual, transgender, and queer) equality in the United States and in many countries around the globe, LGBTQ+ students on college campuses still experience bias, hostility and discrimination. Engineering departments on campus in particular have been slower than other departments to respond to efforts to effect a positive change for LGBTQ+ individuals [1, 2]. Researchers and practitioners began working together in 2015 to advance LGBTQ+ inclusion in engineering classrooms and workplaces. This paper presents research-informed promising practices for creating LGBTQ+-inclusive climate in engineering departments. The specific focus is on strategies that can be adopted by individual faculty members to support LGBTQ+ inclusion for engineering students in academic spaces.

Farrell, S., & Minerick, A. R. (2018). The stealth of implicit bias in chemical engineering education, its threat to diversity, and what professors can do to promote an inclusive future. *Chemical Engineering Education, 52*(2), 129-135.

> Using five illustrative examples, this paper explores how, despite unprejudiced conscious values, unconscious bias can cause engineering educators to contribute to an uneven playing field that influences who gets messages to enter chemical engineering, as well as who succeeds in chemical engineering and who does not.

Riley, D., & Claris, L. (2009). From persistence to resistance: pedagogies of liberation for inclusive science and engineering. *International Journal of Gender, Science and Technology, 1*(1), 36-60.

> Abstract - This paper describes liberative pedagogies and their implementation in a women's college engineering classroom. A variety of assessment techniques employed in the first three years of a five-year study on liberative pedagogies in engineering reveal a clear dynamic of resistance. Assessment data are interpreted drawing on Foucault's theory of resistance, developmental theories of critical thinking and reflective judgment, and the literature on liberative pedagogies itself, in order to better understand the causes and focal elements of resistance, and in order to evaluate the role of resistance in the learning process. How can we apply ideas from feminist and critical pedagogies in science and engineering classrooms? How do these pedagogies of liberation challenge students' epistemological assumptions, that is how they know what they know, and epistemologies of science? How do we make sense of student resistance in the classroom, and how can we tap this resistance as a positive learning tool? If the role of women (and men) in engineering changes from persister to resister, even a group small in number may have a large and long-lasting impact on engineering education and practice.

Riley, D. M., & Claris, L. (2003). *Pedagogies of liberation in an engineering thermodynamics class.* Paper presented at the American Society for Engineering Education Annual Conference.

> Abstract - Pedagogies of liberation, including feminist and critical pedagogies based on the works of bell hooks, Paulo Freire and others, were employed in teaching Engineering Thermodynamics with two classes of women at Smith College. Aspects of course development, assignments, and classroom dynamics are discussed, including connecting course material to student experience,

emphasizing students as authorities in the classroom, integrating ethics and policy considerations, problematizing science as objectivity, and de-centering western (and male) civilization. Appropriate assessment methods for this type of course are presented with results from the first two classes, pointing to areas for further development. Critiques and limitations of the use of liberative pedagogies in engineering education are discussed, as well as the potential for these methods to address the needs of all students while increasing the accessibility and attractiveness of engineering for underrepresented groups.

Smith, J. M., & Lucena, J. C. (2015). *Making the funds of knowledge of low income, first generation (LIFG) students visible and relevant to engineering Education.* Paper presented at the ASEE Annual Conference, Seattle, WA.

Though engineering is often perceived as a pathway of upward mobility in the United States, very little is known about the experiences of undergraduate engineering students who come from low-income backgrounds or are the first in their families to attend college. The scant research that does exist about low income, first generation students (LIFGs) is grounded in a deficiency model, focusing on what these students lack. Our project breaks with the existing scholarship by identifying the ways in which LIFG knowledges and experiences outside the classroom, including the practical knowledge they develop in their lives and at work, could offer innovative ways for all students to define, solve and design for pressing engineering problems. Through ethnographic and collaborative research with LIFGs at a public engineering university and a community college, we identify students' funds of knowledge, or the knowledge gained from students' family and cultural backgrounds, that is crucial to engineering innovation but neglected in the curriculum they encounter in college. These funds of knowledge include defining and solving problems in the midst of financial and material scarcity; building, fixing, and adapting technical artifacts and systems; and empathizing with marginalized groups and communities. We suggest that these knowledges position LIFGs as effective innovators of engineering design for community development, though few pursue this path because of financial constraints. Finally, we identify future pathways of this exploratory research, including a) an international collaboration investigating the role of socioeconomic class for teaching and learning about engineering design and community engagement; b) a mentoring program between the engineering university and community college under study, including a university outreach program to assist LIFGs enhance their résumés; and c) strategies to bring LIFG funds of knowledge into engineering science and design courses.

Gomez, J., & Svihla, V. (2018). Rurality as an Asset for Inclusive Teaching in Chemical Engineering. *Chemical Engineering Education, 52*(2), 99-106.

We developed and tested a pedagogical strategy--asset-based design challenges--to enhance diversity in early chemical engineering coursework. Using qualitative methods, we found first-year students justified high-cost solutions with ethical arguments; teams that included rural expertise argued instead for economically-viable solutions. In the sophomore class, students used cost and environmental impact to make decisions about rural concerns. These findings demonstrate that students learned from their rural peers and leveraged this information as they made design decisions.

Inclusive Teaching in Engineering

Resources related to inclusive teaching in STEM

- ASEE recorded webinars on inclusive teaching
  https://www.asee.org/education-careers/continuing-education/webinars
- ASEE CDEI Virtual Workshops
  https://diversity.asee.org/deicommittee/category/resources/virtual-workshops/
- CRLT-ENGIN Inclusive Teaching in Engineering – University of Michigan Center for Research on Learning and Teaching in Engineering resources for inclusive teaching in engineering
  https://crlte.engin.umich.edu/inclusive-teaching/
- Engineering Inclusive Teaching – WEPAN's resources for inclusive teaching in Engineering
  https://www.wepan.org/page/EIT
- Gendered Innovations (Research and case studies on sex/gender/intersectional analysis leading to innovation)
  https://genderedinnovations.stanford.edu/
- Rowan RevED Inclusive Curriculum
  https://research.rowan.edu/research-areas/engineering/reved/curriculum/index.html