GIFTS: Framing Understanding Implicit Bias as a Professional Skill to First-Year Students

Dr. Jeffrey W. Fergus P.E., Auburn University

Jeffrey W. Fergus received his B.S. in Metallurgical Engineering from the University of Illinois in 1985 and Ph.D. in Materials Science and Engineering from the University of Pennsylvania in 1990. After a postdoctoral appointment at the University of Notre Dame he joined the Materials Engineering program at Auburn University in 1992. He is currently the Associate Dean for Undergraduate Studies and Program Assessment in the Samuel Ginn College of Engineering.

Jessica Bowers, Auburn University - Samuel Ginn College of Engineering

Jessica Bowers serves as the Manager for Career Development Content and Strategy in the Samuel Ginn College of Engineering (SGCOE) at Auburn University. In August 2018, Jessica joined the SGCOE to support the launch of the Office of Career Development and Corporate Relations (CDCR), charged with providing career development and graduation outcome support for 6,300 undergraduate and graduate engineering students. She provided leadership and strategic direction for establishment of CDCR career development and coaching services; leading recruitment, staffing, and operation of the career coaching team to provide one-on-one career coaching, workshops and programs, class presentations, and print and electronic resources. In 2022, Jessica transitioned her role to focus on developing a framework and infrastructure of embedded career development content and outcomes at strategic intervals within the engineering student experience.

In 2020, Jessica joined the Inclusion and Diversity Committee within the SGCOE, consisting of faculty, staff, and students. Within that committee, she leads a task group responsible for the branding, exposure, and promotion of diversity, equity, and inclusion efforts in the college which launched the Engineer Together branding initiative in 2021. In 2022, the SGCOE awarded Jessica with the Leadership in Diversity Faculty / Staff Award in recognition of one faculty or staff member per year who serves as an advocate for diversity in engineering.

Prior to joining Auburn University, Jessica spent 4.5 years as an Assistant Director for Pre-Health and Law Advising at the University of Virginia. Prior to UVA, she provided academic advising at the University of Tennessee - Knoxville where she also completed her master of science in college student personnel. Jessica holds a bachelor of arts in organizational communications and psychology from the University of North Carolina at Charlotte.

GIFTS: Framing Understanding Implicit Bias as a Professional Skill to First-Year Students

Introduction

Discussion of engineering curriculum development often focuses on technical knowledge and skills needed to prepare students to design engineering solutions. However, the context in which these solutions are applied is important as indicated in the first cannon in the National Society of Professional Engineers (NSPE) Code of Ethics which states that "engineers shall hold paramount the safety, health, and welfare of the public" [1]. The focus on preparing students for the technical demands of engineering design may lead to them not fully appreciating the societal impact of engineering solutions. Cech [2] studied the evolution of the interest of students in public welfare issues, such as ethical responsibilities, understanding the consequence of technology, understanding how people use machines and social consciousness, as they proceeded through their engineering programs and found that the level of interest in these issues declined. The decline was attributed to attitudes that non-technical concerns were not relevant to "real" engineering and similarly social competencies were valued less than technical skills. In addition, an emphasis on meritocracy leads to the view that social structures are fair and just, such that they need not be of concern for engineers.

Niles et al. [3] found that even students in programs that had well-established engagement in public welfare had difficulty appreciating the value of non-technical skills as part of their identity as engineers. Litchfield and Javernick-Will [4] found that students who did have interest in social issues considered those interests to be a part of their non-engineer identity. Similarly, Schiff et al. [5] found that students sometimes have difficulty connecting personal ethical considerations with professional ethical considerations.

In another study, Bielefeldt and Canney [6] found that the interest of social justice among most (57%) students were unchanged during their undergraduate engineering programs with smaller amounts increasing (20%) or decreasing (23%). In a subsequent study, Rulifson and Bielefeldt [7] found that students developed an appreciation for ethics and the bettering of society, but that this was on general benefits, such as safety, rather than focused on issues that might differentially impact marginalized communities.

These studies demonstrate that there is a need to help engineering students better understand and appreciate the impact that their work has on society and develop skills needed to provide effective and equitable solutions. This need is evident in developments in the criteria for accrediting engineering programs. In October 2022, the ABET Engineering Area Delegation approved an optional two-year pilot criteria that incorporates principles of diversity, equity and inclusion (DEI). One of the elements of these changes is that the curriculum must include "content that ensures awareness of diversity, equity, and inclusion for professional practice consistent with the institution's mission." [8] Experience with the pilot study will be used to inform future modification of the criteria to incorporate DEI principles.

Approach

This study focused on a skill needed for students to prepare equitable solutions for a diverse population and for working effectively on teams with members who are different from themselves – specifically an understanding of implicit bias. Topics in the DEI space, like implicit bias, are politically charged and thus need to be presented tactfully to avoid a defensive reaction which can shut down conversation. Thus, using a business case [9] rather than moral arguments is likely to be more effective for engaging individuals not predisposed to discussion of DEI issues. In this case, the business case was to frame understanding implicit bias as a professional skill that would lead to more successful product development rather than as a DEI topic. The discussion of implicit bias was developed in collaboration with professionals from the university's Office of Inclusion and Diversity. The intervention was a single class period on professional skills in an orientation course that is required of all first-year engineering students (freshmen and transfer students).

The session opens with a discussion of ABET accreditation and the student outcomes that are identified in the Engineering Accreditation Criteria as the knowledge and skills that students are expected to demonstrate before graduation to be prepared for engineering careers. The focus of this discussion is to point out that not all the student outcomes are technical and that non-technical skills are required to be a successful engineer. This is followed by a discussion of the career-ready competencies identified by the National Association of Colleges and Employers (NACE) which are listed in Table 1 [10]. After review of the outcomes and competencies, students are asked to reflect on the competencies in which they are most confident at this stage of their education and then participate in an exercise to assess the competencies needed when developing a new product.

The Poll Everywhere platform was used to crowdsource responses to the question, "Which of the following competencies have you developed during your first year at the university or based on your experience up to this point?" The number of competencies a student could indicate in their response was not limited and they were not ranked. Students submitted to the electronic poll by text and the accumulated responses were displayed on the screen in real time, which provided response visualization. In conducting this exercise over multiple semesters in virtual and face-to-face formats, responses were collected from four class sections consisting of 1,036 students (spring 2022 – one freshmen class of 149 students, one transfer class of 69 students; fall 2022 – two freshmen class sections of 818 students). The results in Figure 1 show that

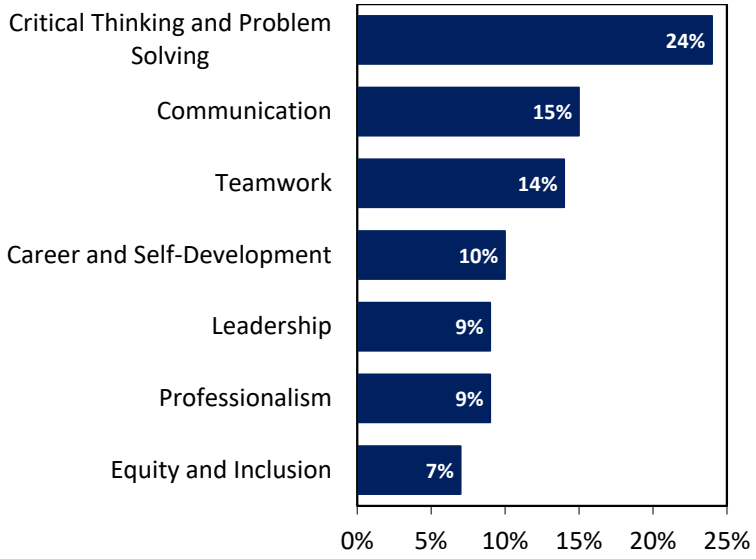

Figure 1: Self-reported competency development among first-year engineering students (freshmen and transfer).

Table 1. NACE Career-Ready Competencies [10]

Critical Thinking and Problem Solving	• Identify relevant information and analyze data. • Collaborate to develop and test possible solutions. • Adopt multiple perspectives and distinguish between fact and opinion.
Communication	• Create and edit written reports. • Adjust communication based on audience. • Listen well and read body language. • Articulate clearly and accurately when speaking and writing.
Teamwork	• Effectively communicate to define common goals. • Reach consensus on process and solutions. • Work together to identify and utilize the strengths of each member.
Technology	• Value continuous learning. • Be responsive to a variety of training formats. • Ability to adapt to new and emerging technology. • Use technology ethically and efficiently to solve problems and accomplish goals.
Leadership	• Manage projects from beginning to end. • Define and clarify roles, objectives, and processes. • Coach others on performance improvement. • Understand how to motivate others and delegate responsibilities.
Professionalism	• Work productively with others. • Manage time and workload. • Have a professional work image and use social media responsibly. • Demonstrate integrity and ethical behavior. • Act with the interests of the larger community in mind. • Learn from mistakes.
Career and Self-Development	• Identify areas of professional growth. • Navigate and explore job options. • Take necessary steps to pursue and advocate for opportunities in the workplace.
Equity and Inclusion	• Interact effectively with people from diverse backgrounds. • Understand one's own biases and use that awareness to work to eliminate them. • Solicit and use feedback from multiple cultural perspectives to make equity-minded, inclusive decisions.

students consistently reported the highest confidence level in the critical thinking and problem solving competency and least confidence in the equity and inclusion competency. While results varied slightly among the freshmen and transfer student populations and in the fall versus spring semesters, differences were minor and reflected a slight variation of confidence levels among the professionalism, career and self-development, leadership, and technology competencies across the four class sections.

The students were then asked to discuss a scenario where they were tasked with developing a product - specifically to develop the latest voice recognition technology for a product consumers can wear as a ring. Students were asked to consider one of the initial steps within the product development process. This required them to consider the populations from which engineers need to seek input in the early stages of the technology and ring prototypes. The students then responded to a second electronic poll inquiring about the career readiness competencies that are most necessary for this stage of their product design, which leads to a discussion about the social and non-technical competencies that are so critical in early stages of a project. The instructor further reviewed the critical nature of specific career readiness competencies in this scenario recognizing that professionalism and equity and inclusion are among the competencies in which students conveyed the least confidence. This exercise led to a discussion of some engineering products that have failed because the needs of particular populations had not been considered,

such as designs based on male specifications (size of cell phones, airbags, building temperature regulation) or optical devices that did not work for dark skin. The students were then asked if they thought these were deliberate and if not, why not, which set up a discussion of implicit bias as contributing to these failures.

The focus of the discussion on implicit bias was to demonstrate that we all have implicit biases because of the way the human brain works, but we need to be aware of these biases, so they do not impact our judgments and actions. Examples used, such as automatic word associations, fast-thinking decisions, images that distort perception based on context and videos with distractions, are not controversial and selected to demonstrate how our brains process information and develop perceptions and interpretations that are out of our control. For example, the word associations are used to demonstrate that we tend to respond to prompts with the same word pairings based on common previous experiences in hearing a particular paring and that even reversing the order (e.g. jelly and peanut butter rather than peanut butter and jelly) can sound strange as it not what our brains expect. Similarly, an image used shows how our brain puts alternating light and dark squares in the expected context of a chess board, such that two squares which are the same color due to differential shading of portions of the chess board are perceived to be different colors to fit into the expected pattern. While putting the square colors in the context of a chess board is useful when moving a bishop in a chess game with a partially shaded chess board, putting information into a preconceived pattern can negatively impact judgment and perpetuate biases.

Assessment

The assessment of the impact of the session will be done using an introduction to engineering course that can be taken before, concurrently, or after the orientation course in which the implicit bias session is presented, which will allow for comparison of those who have and those that have not experienced the implicit bias session. A group of faculty and staff members in the college are working with the university writing center to develop reflective writing assignments and associated evaluation rubrics that can be used by faculty members throughout the college. One of those assignments will be implemented in the first-year introduction to engineering course. This assignment will ask students to reflect upon the competencies that they have developed as well as those that they still need to develop to be successful engineers. The extent to which students discuss and indicate the importance of the equity and inclusion competency will be evaluated. Students will indicate if and when they took the orientation course which will provide a mechanism to determine if the implicit bias session led to an increase in the value placed on equity and inclusion.

Summary

The abilities to work effectively on diverse teams and prepare engineering solutions for diverse populations are important for success as an engineer, and these abilities can be impaired by a lack of understanding of one's implicit biases. This relationship has been used to frame an introduction to implicit bias to first-year engineering students as a professional skill to overcome the resistance that some may have to discussion of topics related to diversity, equity, and inclusion.

References

[1] NSPE Code of Ethics, https://www.nspe.org/resources/ethics/code-ethics, accessed 16 January 2023.

[2] E.A. Cech, "Culture of disengagement in engineering education?" *Sci., Tech. Human Values*, vol. 39[1], pp. 42-72, 2014.

[3] S. Niles, S. Contreras, S. Roudbari, J. Kaminsky, and J.L. Harrison, "Resisting and assisting engagement with public welfare in engineering education," *J. Eng. Educ*., vol. 109, pp. 491–507, 2020.

[4] K. Litchfield and A. Javernick-Will, "'I am an engineer AND': A mixed methods study of socially engaged engineers," *J. Eng. Educ*., vol. 104, pp. 393-416, 2015.

[5] D.S. Schiff, E. Logevall, J. Borenstein, W. Newstetter, C. Potts, and E. Zegura, "Linking personal and professional social responsibility development to microethics and macroethics: Observations from early undergraduate education," *J. Eng. Educ*., vol. 110, pp. 70-91, 2021.

[6] A.R. Bielefeldt and N.E. Canney, "Changes in the social responsibility attitude of engineering students over time," *Sci. Eng. Ethics*, vol. 22, pp. 1535-1551, 2016.

[7] G. Rulifson and A.R. Bielefeldt, "Evolution of students' varied conceptualizations about socially responsible engineering: A four year longitudinal study," *Sci. Eng. Ethics*, vol. 25, pp. 939-974, 2019.

[8] D. Steel and N. Bolduc, "Business case for diversity: The tangled web of equity and epistemic benefits," *Philosophy Soc. Sci*., vol 50[5], pp. 418–443, 2020.

[9] ABET EAC Criteria changes, https://www.abet.org/accreditation/accreditation-criteria/accreditation-changes/, accessed 16 January 2023.

[10] NACE Career Readiness Competencies, https://www.naceweb.org/career-readiness/competencies/career-readiness-defined/ , access 26 January 2023.