Resources for Faculty Development: Implicit Bias, Deficit Thinking, and Active Learning

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Abstract

The Improving Student Experiences to Increase Student Engagement (ISE-2) grant was awarded to Texas A&M University by the National Science Foundation through EEC-Engineering Diversity Activities (Grant No. 1648016) with the goal of increasing student engagement and retention in the College of Engineering. The major component of the intervention was a faculty development program aimed at increasing active learning, improving classroom climates, and decreasing implicit bias and deficit thinking among faculty. The program consisted of three workshops, a series of informal coffee hour conversations, and two deliverables from the participants. Workshop 1 consisted of an overview of the ISE-2 program and an introduction to social cognitive biases. Workshop 2 focused on how students learn, provided evidence for the effectiveness of active learning strategies, and exposed participants to these strategies. Workshop 3 prepared participants to apply the material to their own teaching. Coffee hour conversations were conducted on a near-weekly basis between the second and third workshops. Faculty participants created a teaching plan to incorporate what they learned into their own teaching. At the end of the academic year, faculty participants are tasked with completing a final reflection. In this paper, we will report the content of the workshops as related to the overarching goals of the ISE-2 program, along with how the coffee conversation topics complemented the workshop material. Lastly, we will explore the role of the teaching plans and final reflections in changing instructional practices.

Introduction

Improving Student Experiences to Increase Student Engagement (ISE-2) focuses on a faculty development program designed to reduce implicit bias and increase active learning in order to increase underrepresented minority (URM), women, and first-generation students' representation in engineering majors by increasing student engagement, success, and retention. As part of the faculty development program, participants completed three workshops, attended optional informal coffee hour conversations, and wrote teaching plans and reflection papers about their learning and implementation experiences. The purpose of this paper is to describe the currently ongoing ISE-2 faculty development program, including: content and initial implementation of the program, formative changes that occurred from year one to year two, lessons learned throughout the process, and ways to implement a similar program within different settings. We turn first to the motivation for this program and the empirical evidence that links the topics of implicit bias and active learning, student success, and student diversity.

Motivation for the ISE-2 Faculty Development Program

The transition to college can be difficult for students regardless of major. Between 25% and 30% of students do not return to college after their first year [1]. Half of the students who major in science and engineering migrate to another major within the first two years of the program; women and URM students leave science and engineering at even higher rates [2], [3]. These trends are especially concerning when contrasted with the expected job growth in engineering and other STEM fields compared to other professions [4]. Yet the responsiveness within the field of engineering to increasing diversity and inclusion is noticeably slower than that of other professions [5].

ISE-2 attempts to improve engagement and ultimately retention and success for women, URM, and first-generation students in the College of Engineering at Texas A&M University, a Research I land-grant institution. Both academic and non-academic factors influence students' decision to leave engineering programs, including lack of a sense of belonging, difficulty of the program, poor teaching/advising, peer and adult influence, and institutional culture [4], [6], [7]. ISE-2 focuses on several of these factors: lack of sense of belonging, culture within engineering, difficulty of the program, and teaching/advising methods as challenges for students.

Review of Factors that Affect Student Success

Advising and Navigating the University. Advising is important to student success, especially in the early years given the transition to college and the difficulty of classes; it has been identified as particularly important for engineering students [8]. Advising indirectly affects retention through satisfaction and grades [9]. Engineering students--whether they stay in the program or leave--have cited concerns about insufficient advising [3] and lack of services including programs for advising under-represented groups [8]. Given the concerns of engineering students listed previously, advising is inclusive of multiple activities including career counseling, assistance with homework, academic degree planning, and mentoring [9]. Students report that academic concerns are their greatest stressor during their entire undergraduate career, but time management is their biggest concern during the start of their first year [10]. Further, first year students indicate that identifying and navigating university channels for services as one of the more complex problems, which they also recognize as necessary to ensure they get the support they need [8]. Introductory courses within many universities are typically lecture-style, held in large classrooms, and minimize opportunities for communication between students or with professors, who can serve as a resource in helping students navigate learning in this new context [8]. These classroom characteristics may be even more problematic for URM and female engineering students because they are more likely to feel out of place from the outset of engineering classes [3].

Engineering Climate. Engineering climate has commonly been defined as chilly (meaning that the field is unwelcoming and contributes to a lack of sense of belonging) for women, URM, and other underrepresented groups [11], [12]. This is concerning because many positive outcomes such as student engagement, success, and persistence have been associated with a sense of belonging [13]. Chilly climates inhibit a sense of belonging because climate influences how students experience and perceive the values and norms of the program and impacts the quality of student to student and instructor to student communication and interactions [14], [15]. Research suggests that students' sense of belonging and academic integration (expectations students have for positive student-faculty interactions are met), positively relates to self-efficacy [4], [16]. For URM students within STEM fields, insufficient support systems, stereotype internalization, and experiencing racism and isolation have been recognized as elements that influence attrition [17]. Working to improve the climate within undergraduate engineering programs can address these factors and may lead to improvements in the retention of women and URM students. In summary, it is important that instructors are aware of these potential barriers to success, attuned to how students are experiencing learning in their classrooms, and address issues that contribute to a chilly classroom climate, focusing on (among other factors) instructor behavior, student-to-student behavior, communication, and other implicit or explicit messages that impact students' sense of belonging.

Program Difficulty. Engineering programs are rigorous and include mathematics and science classes that are often taught without context to the field of engineering. Over 90% of students who leave science commented about the poor quality of teaching, citing problems with the classroom learning environment, lack of organization on behalf of instructors, and instructor lectures not being engaging [18]. Further, students feel as if classes are designed with the intention to eliminate students from the program [4]. Research suggests that engaging students with course material, as well as purposefully being inclusive of URM students, is beneficial for a diverse array of students [5]. Additionally, engaging educational approaches such as cooperative or project-based learning have been shown to be beneficial in engaging all students [19].

Overview of ISE-2 Program

With a goal of improving retention and student experiences, ISE-2 addresses the academic and socio-cultural issues discussed above that contribute to challenges students face in engineering. ISE-2 focuses on these issues by providing faculty with information about active learning, classroom climate, and social-cognitive biases that instructors and/or fellow students can exhibit that can negatively impact the learning environment. The overarching hypothesis of this project is: by developing faculty knowledge on social cognitive biases and strategies to reduce them, as well as improving faculty skills and applying student-engaging instructional approaches, faculty will transform their instructional practices. These newly transformed instructional practices will improve student engagement and classroom climate, ultimately improving student success and

retention. In the following, we describe the ISE-2 program and its content, as well as the formative changes we made from Year 1 to Year 2.

Figure 1 depicts the general timeline for the faculty development program, which was held in two consecutive summers with two cohorts of faculty participants. Prior to participating in the program, project team members observed faculty teaching a class and their students were surveyed as part of the project evaluation process (not individual faculty evaluation); observations and surveys continued in the semesters following faculty participation. During the summer program, faculty engaged in two 3-hour workshops held within a few weeks of each other. Less formal coffee conversations (1.5 hours each) on topics chosen by participating faculty were held over approximately five weeks, followed by a final 3-hour workshop. Participants then completed a teaching plan that summarized their learning and how they intended to apply it to their courses in the upcoming academic year.

Figure 1. ISE-2 Timeline

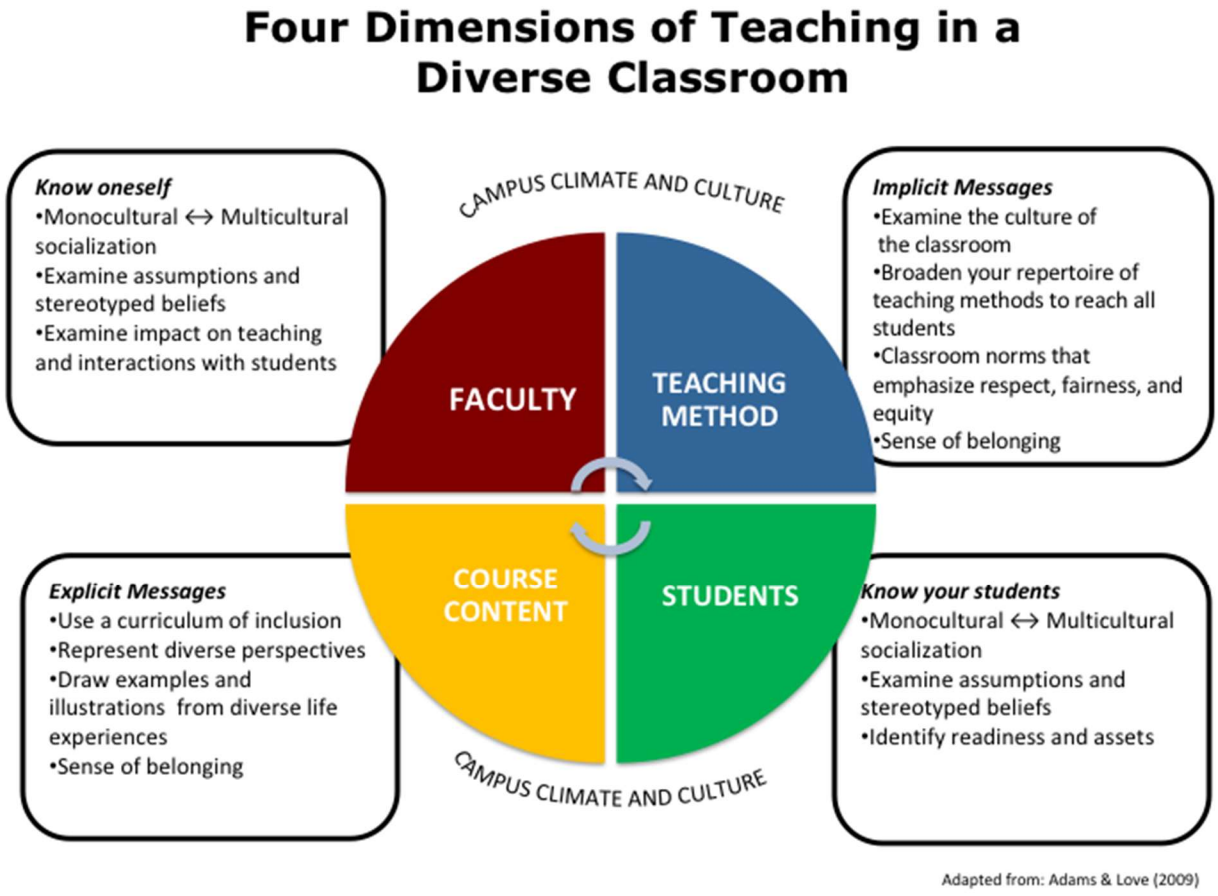
Time Period	Events
Spring	Recruitment; Classroom Observations and Student Surveys
Early May	Workshop 1: Improving Student Experiences to Increase Student Engagement
Mid-May	Workshop 2: Engaging Students in Learning
June-July	Coffee Conversations: Working in Teams, Assessment on the Fly, Developing Good Exam Questions, Defusing Microaggressions in the Classroom, How Students Study Poorly and What to Do About It, and Tying It All Together: Considerations for Course Change
Early August	Workshop 3: Planning for Change and Teaching Plan
Fall	Classroom Observations and Student Surveys
Spring II	Additional Classroom Observations
Summer II	Faculty Final Reflections Completed

Year One

Workshops

Three workshops were developed to address the major topics of the ISE-2 curriculum. Two were held at the beginning of summer and the third was held approximately one month prior to the start of the Fall semester. The workshops were approximately 9 total hours of classroom time. Resources were provided to faculty participants in the form of articles and handouts. Materials served to build on content covered in the workshops.

Figure 2. Four Dimensions of Teaching in a Diverse Classroom



All three workshops were anchored by a model for teaching in a diverse classroom [20]. This model highlights the complexity of teaching and learning given the diversity of students, faculty, and disciplines as illustrated in [20, Fig. 2]. The model highlights the dynamic interaction among faculty, students, course content, and teaching methods and the impact of those interactions on teaching and learning. Each of these factors impacts different levels of interaction in the

classroom. For example, dynamic interactions occur between both faculty members and students, as well as students with their peers in the classroom. The model posits that a deeper awareness of these variable and critical interaction patterns is valuable for the shaping of students' unique learning experiences. Further, it serves to foster the importance of being aware of students' and one's own unique background, experiences, and social identities and how this influences the teaching decisions that faculty make, as well as how the classroom experience is received by students. Applying this framework when making pedagogical choices allows for more reflective decision-making aimed at supporting all students, particularly those who have historically been underserved and underrepresented [20].

Designing the workshops around this model created an opportunity for faculty to reflect on how to create a sense of belonging in their classrooms, specifically in the context of engineering. For example, while the course content in an engineering course may not directly lend itself to incorporating diverse perspectives that help students see themselves in the discipline, faculty shared ideas of how they might highlight the work of women and people of color who are engineers. Additionally, emphasis was placed on the importance of creating relevance of the course content for all students. For example, delineating to students that there are many options for application of different engineering degrees and encouraging them to explore them to find the best fit based on their unique interests. In terms of addressing the specific barrier of culture within engineering, faculty were familiarized with the portion of the framework that emphasizes the importance of the quality and nature of interactions between students and instructors in the classroom. Faculty were encouraged throughout this workshop and the project to take initiative in reaching out to their students in simple ways, such as inquiring how students' first week of classes were going, in an attempt to build rapport and foster a connection with each student. Emphasis was placed on the powerful nature of connecting with students in this manner. The remaining barriers and how they were addressed by the ISE-2 project will be discussed in the following section.

Workshop 1. The learning outcomes for Workshop 1 consisted of: a general program overview, defining implicit and explicit bias and microaggressions, and examining dimensions of identity and impact on teaching. The session began with a project overview and goals, rationale, and timeline. This included institutional data regarding student experiences in the engineering program, which was used to demonstrate the importance of ISE-2 goals.

The quadrant of the Four Dimension Model that was most highlighted in this first session was the quadrant titled "Faculty", with focus on the theme of "Knowing Oneself". This consisted of the faculty being guided on how to examine their own stereotyped beliefs and assumptions, as well as the impact of their own views on their teaching of and interactions with students with diverse backgrounds. Implicit bias is typically expressed indirectly, and is unconscious; it centers around unchallenged assumptions. In contrast, explicit bias is expressed directly and easy to

recognize. Explicit bias is often deliberate, conscious, and aware. Microaggressions are brief and commonplace daily verbal, behavioral, and environmental indignities, whether intentional or unintentional, that communicate hostile, derogatory or negative slights and insults to the target group or person [21]. Deficit thinking was also defined in Workshop 1. Deficit thinking occurs when a student's academics struggles and differences in educational outcomes are attributed to cultural stereotypes, inadequate socialization, or lack of motivation and initiative on the part of the student [22].

Further, varying dimensions of identity are based on the notion that each individual has different layers to his or her identity based on both primary and secondary variables. Primary variables can include factors such as race, sexual orientation, and age, while secondary variables can include education, work experience, religion and geographic location. The interaction and overlap of such factors that make up one's identity influence self-image, opportunities, values, and expectations [23]. Further, faculty were encouraged to examine assumptions and stereotyped beliefs, and recognize their potential impact on faculty to student interactions, as well as on course design decisions. To foster engagement during the workshop, faculty participated in structured activities such as think-pair-share, which prompted discussion amongst participants and their unique experiences thus far in their teaching careers. Think-pair-share is a strategy that allows participants to think individually on a question posed, then pair up with others to share responses within the group to allow for more interaction and engagement amongst participants than a typical lecture format.

Workshop 2. The learning outcomes for Workshop 2 were: discuss basics of how students learn in the classroom, how instructors can encourage student engagement, and demonstrate and use interactive learning strategies. Workshop 2 served to highlight concepts covered in Workshop 1, connect them to additional learning theories, and provide evidence-based instructional strategies to improve student engagement and learning.

Workshop 2 primarily focused on the "Teaching Method" and "Students" quadrants of the Four Dimension Model. Topics covered related to the "Teaching Methods" quadrant included memory and cognition, setting the stage for learning, strategies to engage students, assessment on the fly, cooperative learning, and using technology in large classrooms. In relation to the "Students" quadrant, topics covered consisted of: how students learn, working in teams, study skills, and defusing microaggressions in the classroom. Participants were asked to reflect on their own unique experiences in their classrooms to best connect these concepts to their teaching styles, challenges, and successes thus far. Strategies to overcome common barriers to learning and engagement were discussed. Further, specific strategies targeting a high percentage of student engagement with class material were presented (discussed below). These strategies were presented in a manner that highlighted the importance of utilizing certain methods that aim to foster connections between students and the course material. More specifically, we discussed

how active learning strategies can be utilized to help students make meaning of the course content.

Active learning allows for students to process the material through methods such as activities like role playing, videos, or games [24]. While the material being presented often remains constant across instructors of the same course, a different modality of presentation has the potential to influence the rate of student success and level of engagement. Different strategies utilizing active learning techniques were presented to the faculty as being crucial tools to provide students the opportunity to process and apply course content in a way where a deeper level understanding and connection is mastered. Specific strategies included providing students with advance organizers to help them focus on important information and developing concept maps to help them make connections to course concepts. When this level of understanding is mastered, students have formed a connection to the material that allows for them to apply it in different contexts when necessary [25]. Regarding the difficulty level of the engineering program, this portion of the ISE-2 workshop aimed to encourage the faculty to engage in active teaching methods in order to best serve their students throughout the rigorous nature of the departmental-level courses. Strategies for engaging students with the material to best establish a deep level of understanding, with the ultimate goal of satisfactory course grades, were presented and suggested for implementation in the faculty members' courses. Discussion prompts were utilized to engage the faculty members in reflecting on their own thoughts and ideas about how they could incorporate interactive learning strategies into their instructional practices. Additionally, resources were provided for faculty to further explore tools used to create interactive activities for their students in the classroom and faculty shared with each other strategies they used previously and lessons they learned when implementing them.

Workshop 3. The learning objectives for Workshop 3 were: review program and sessions, discuss course design, review the Four Dimension Model, and plan for change in the classroom. Workshop 3 provided a review of topics discussed in previous sessions, a review and summary of the framework for teaching in a diverse classroom, and a future-oriented presentation and discussion targeting each participant's plan for change in his or her teaching methods. More specifically, the framework was reviewed thoroughly, tying together workshop content to each quadrant and relationships among the quadrants. Topics from previous workshops and coffee conversations were presented individually alongside the visual model of the framework to clarify these relationships and allow for the recall of discussions pertaining to each part of the framework. Further, questions were provided to prompt discussion about the faculty's ideas for changes to their courses and to begin the process of thinking about implementation specifically in the context of this framework.

Coffee Conversations

In contrast to the three workshops, informal, less structured coffee conversations were provided as a resource for participants to engage further with each other and topics related to the ISE-2 project. The coffee conversations took place approximately weekly between Workshops 2 and 3. Attendance was optional and designed to be an opportunity for participants to gain a more in-depth understanding about topics covered in the workshops. Handouts and worksheets were provided at each coffee hour and served to guide the coffee hour discussions. Further, the conversations tended to be smaller groups than the workshops, which fostered an atmosphere conducive to in-depth conversation amongst each participant and their colleagues.

Topics covered in the coffee hours were variable and were chosen by the ISE-2 team as being important to achieving the overall goals of the project. Also, certain topics were chosen by the participants due to interest. Topics for the first cohort faculty included "Working in Teams," "Assessment on the Fly," "Developing Good Exam Questions," "Defusing Microaggressions in the Classroom," "How Students Study Poorly and What to Do About It," and "Tying It All Together: Considerations for Course Amendments." The topics remained the same for the second cohort of faculty, with the exception of "Developing Good Exam Questions". An additional session was added for the second cohort that focused on using technology in a large classroom.

Faculty Response: Focus Groups

Focus groups were conducted to gather information about the participants' experiences in the first year of the ISE-2 project. Multiple focus groups were conducted, and each contained fewer than five people per session to allow for each individual to contribute fully. Several main points that were highlighted by multiple participants included the desire for more succinct scaffolding of lessons and topics, more preparation prior to creating the plan for change in the classroom and the final workshop, and more explicit learning objectives. Information gathered from the first cohort of faculty was utilized in revamping preparation materials, workshop slides and materials, and coffee hour conversation topics and goals for the second year of implementation.

Year Two

Changes from Year One

Workshop materials prior to the first session were adjusted for the second year of workshops. Rather than including articles only, the method of delivery was more variable in an effort to serve as more engaging for the participants. More specifically, they included activities such as a short "quizzes," along with brief articles and videos to familiarize participants with the content

prior to beginning face-to-face discussion in the workshops. Additionally, they were provided to faculty prior to each workshop rather than during each workshop.

Content from Year 1 to Year 2 was not altered significantly. Topics remained constant, but emphasis on information was changed to fit faculty feedback from the focus groups. For example, less time was spent in Workshop 1 on institutional data about student experiences because the faculty indicated that they were convinced of the need prior to joining the development program and only became more convinced by the data presented; thus, we deemed that this was only needed to frame our goals rather than to convince participants of the importance of the work.

The major change was to increase scaffolding of topics across the three sessions. Year 1 consisted of references to the Four Dimension Model, but lacked the utilization of scaffolding of the information from each quadrant. More scaffolding was implemented in Year 2 to increase understanding of the material and connection between topics of discussion. For example, faculty were introduced to the concept of deficit thinking and how it ties to bias in the first workshop as opposed to introducing it during the final workshop. Deficit thinking was defined and outlined through examples in Workshop 1, followed by the presentation of alternative ways of thinking to challenge this common issue in the classroom. Further, discussion prompts were utilized to tie conversation back to this concept during latter sessions. Along with this, more preparation for the final workshop was incorporated into the other workshops. A stronger tie was established to the framework when discussing the various topics to better emphasize the significance of the model. The framework was referenced more frequently to provide more opportunities for both retention of the information and clarification. For example, a preview of a new portion of the framework after the end of session one, prior to session two, was provided to give faculty an idea of what to expect next. Visual presentation and discussion prompts related to the framework at both the beginning and end of sessions were utilized in a more routine manner for the purposes of Year 2 of implementation and delivery of material.

Overall, the ISE-2 team gathered valuable information from the pilot year to the second year of implementation through experience and input from faculty members both along the way and in the focus groups after the conclusion of the faculty development sessions. Over time, the ISE-2 team learned that the use of an overarching model is effective only if it is closely tied to each piece of the project, including both workshop concepts and coffee hour discussions. It is crucial to refer back to the model frequently, with a review of how it connects to both small concepts and larger ones. During the focus groups, the faculty indicated that they did not understand the ways in which the Four Dimension Model and its pieces fit together in conjunction with topics of discussion covered during the workshops and coffee conversations. Feedback from faculty indicated that a clear, unifying framework to refer to consistently was necessary for full effectiveness. Further, providing resources and opportunities for considering implementation of

learned material in the classroom was most effective in bits and pieces rather than during one presentation as a finale to the workshops series. Additionally, providing more opportunities for questions regarding terminology and the framework will be helpful for the faculty to avoid gaps in learning that can hinder the overall effectiveness of the program and creating change in teaching approaches.

Implementation in Other Settings

Other universities--and other programs--might have interest in adapting some or all of these materials for their own use. The materials utilized for the faculty development workshops and coffee conversations are flexible enough to be molded for other contexts. Although geared towards university faculty, the material goals and objectives fit groups of teaching faculty in other settings such as professional development workshops. However, faculty buy-in and motivation to implement the program should be addressed because the faculty commitment is extensive. Implementation should focus on presenting information that demonstrates the needs of the population and how improvements requested may be beneficial in improving lives and performance metrics for the departments. Specific to ISE-2, a comparison of URMs to the overall population on first-year retention data and six-year graduation rates was used as metrics to help faculty understand the importance and need for change within the program. Further, faculty were provided with results of a survey that spoke to experiences and climate from the perspective of URMs including likelihood of being interrupted by fellow students, having judgment doubted by students, perception of how fellow students pay attention to or show interest in statements and opinions, having jokes made at their expense, and experiences of hostility from other students. It is especially important that the faculty see data for URMs because at this specific institution, the number of minority students is extremely low and may make it easy for faculty to dismiss the needs of the unheard. Additionally, the usage of statistics specific to the institution being studied is important in addressing faculty buy-in as it shows how these changes affect students that the faculty actually instruct or advise.

Cohorts were limited to 10 or fewer participants, in an effort to foster an appropriate level of engagement with the material but also provide the opportunity for paired and small group discussion. However, the materials can be used as a presentation to a larger group, with similar activities still utilized for engagement. Coffee conversation groups were also kept small in number. If desired to use with a larger group of teaching professionals or faculty, coffee conversations could be scheduled more frequently to still maintain the small group atmosphere. Additionally, the observation process can be used in other instructional settings such as seminars and workshops. If interested in accessing the materials, they are available at: http://bit.ly/ise2materials.

Conclusion

In closing, ISE-2 is designed to increase student engagement and retention in engineering undergraduate students through workshops, coffee conversations, and focus groups. The faculty development program does so by increasing awareness of how implicit bias can impact classroom instruction and climate; reducing the effects of implicit bias in the teaching and learning context; and increasing the utilization of active learning teaching strategies to improve student success. Our framework and approach address common challenges of students based on the literature, including a lack of sense of belonging, culture within engineering, difficulty of the program, and teaching/advising methods. This paper details the ISE-2 program over the course of two years and further discusses potential implementation of similar programs in other settings.

References

[1] J. L. Rausch and M. W. Hamilton, "Goals and distractions: Explanations of early attrition from traditional university freshmen," *The Qualitative Report*, vol. 11 no. 2, p. 317-334, June 2006. [Online]. Available: https://nsuworks.nova.edu/tqr/vol11/iss2/6/. [Accessed January 13, 2019].

[2] M. Crawford and K. Schmidt, "Aim for Engineering: Lessons Learned From A K 12 Project." in *Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition,* Salt Lake City, Utah [Online]. Available: https://peer.asee.org/12892 [Assessed 13 January, 2019].

[3] E. Seymour and N. M. Hewitt, *Talking about leaving: factors contributing to high attrition rates among science, mathematics & engineering undergraduate majors: final report to the Alfred P. Sloan Foundation on an ethnographic inquiry at seven institutions*. Ethnography and Assessment Research, Bureau of Sociological Research, University of Colorado, 1994.

[4] R. M. Marra, K. A. Rodgers, D. Shen, and B. Bogue, "Leaving engineering: A multi-year single institution study," *Journal of Engineering Education*, vol. 101, no. 1, pp. 6-27, January 2012.

[5] J. Gill, M. Ayre and J. Mills, "Revisioning the Engineering Profession: How to Make It Happen!," In *Gender and Diversity: Concepts, Methodologies, Tools, and Applications*, Vol. 1, IGI Global. 2019, pp. 427-442.

[6] Q. Li, H. Swaminathan and J. Tang, "Development of a Classification System for Engineering Student Characteristics Affecting College Enrollment and Retention," *Journal of Engineering Education*, vol. 98, no. 4, pp. 361–376, October 2009.

[7] M. Meyer, and S. Marx, "Engineering dropouts: A qualitative examination of why undergraduates leave engineering," *Journal of Engineering Education*, vol. 103, no. 4, pp. 525-548, October 2014.

[8] S. Haag, N. Hubele, A. Garcia and K. McBeath, "Engineering undergraduate attrition and contributing factors," *International Journal of Engineering Education*, vol. 23, no. 5, pp. 929-940, October 2007.

[9] K. L. Sutton, and C. Sankar, C, "Student satisfaction with information provided by academic advisors," *Journal of STEM Education: Innovations and Research*, vol. 12, no.7, pp. 71-85, October 2011.

[10] M. Hoffman, J. Richmond, J. Morrow and K. Salomone, "Investigating "sense of belonging" in first-year college students," *Journal of College Student Retention: Research, Theory & Practice*, vol. 4 no. 3, pp. 227-256, November 2002.

[11] E. Litzler, S. E. Lange and S. G. Brainard, "Climate for graduate students in science and engineering departments," *in Proceedings of the 2005 American Society for Engineering Education annual conference & exposition, 12-15 June 2005, Portland, Oregon* [Online]. Available: http://citeseerx.ist.psu.edu. [Accessed: 13 January 2019].

[12] G. M. Walton, C. Logel, J. M. Peach, S. J. Spencer and M. P. Zanna, "Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering," *Journal of Educational Psychology*, vol. 107, no. 2, pp. 468-485, May 2015.

[13] S. C. Davis, E. C. Moise, N. Cheon and S. B. Nolen, "Investigating Student Perceptions of an Engineering Department's Climate: The Role of Peer Relations," in *Proceedings of the 2018 ASEE Annual Conference, 24-27 June 2018, Salt Lake City, Utah* [Online]. Available: http://www.asee.org [Accessed: 14 January 2019]

[14] M. T. Wang and J. L. Degol, "School climate: A review of the construct, measurement, and impact on student outcomes," *Educational Psychology Review*, vol. 28 no. 2, pp. 315-352, June 2016.

[15] S. Secules, A. Gupta, A. Elby and C. Turpen, "Zooming Out from the Struggling Individual Student: An Account of the Cultural Construction of Engineering Ability in an Undergraduate Programming Class," *Journal of Engineering Education*, vol. 107, no. 1, pp. 56-86, January 2018.

[16] C. Vogt, "Faculty as a critical juncture in student retention and performance in engineering programs," *Journal of Engineering Education*, vol. 97, pp. 27–36, January 2008.

[17] J. M. Trenor, S. L. Yu, C. L. Waight, K. S. Zerda and T. L. Sha, "The relations of ethnicity to female engineering students' educational experiences and college and career plans in an ethnically diverse learning environment," *Journal of Engineering Education*, vol. 97 no. 4, pp. 449-465, October 2008.

[18] J. Watkins and E. Mazur, "Retaining students in science, technology, engineering, and mathematics (STEM) majors," *Journal of College Science Teaching*, vol. 42, no. 5, pp. 36-41, May 2013.

[19] G. Lichtenstein, H. L. Chen, K. A. Smith and T. A. Maldonado, "Retention and persistence of women and minorities along the engineering pathway in the United States," in *Cambridge handbook of engineering education research*, Cambridge: Cambridge University Press, 2014, pp. 311-334.

[20] M. Adams and B. J. Love, "A social justice education faculty development framework for a post-Grutter era," *Social justice education: Inviting faculty to transform their institutions*, K. Skubikowski, C. Wright and R. Graf, Ed. Virginia: Stylus Publishing, pp. 3-25, 2009.

[21] D. W. Sue, *Microaggressions in everyday life: Race, gender, and sexual orientation*. Hoboken, NJ: John Wiley & Sons, Inc, 2010.

[22] E. M. Bensimon, "Closing the achievement gap in higher education: An organizational learning perspective," *New directions for higher education*, vol. 131, pp. 99-111, 2005.

[23] M. Loden, *Implementing Diversity*, Chicago, IL: Irwin Professional Publishing, 2009.

[24] K. A. Smith, "Craft of teaching cooperative learning: An active learning strategy," in Proc. of *Frontiers in Education Conference, Oct. 15-17 1989, Binghamton, NY* [Online]. Available: IEEE Xplore, http://ieee.org. [Accessed: April 25, 2019].

[25] C. Roettger, L. Roettger, and F. Walugembe, "Teaching: More than just lecturing," *Journal of University Teaching and Learning Practice*, vol. 4 no. 2, 2007. [Online]. Available: http://jutlp.uow.edu.au/2007_v04_i02/pdf/roettger.pdf. [Accessed April 25, 2019].