2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
Paper ID #50395

Making Implicit Gender Bias Visible in Engineering Design: Developing a Curriculum Module for Implementing a Gender-Design Implicit Association Test

Samantha Kang, Oregon State University

Samantha Kang is a Ph.D. Candidate in Mechanical Engineering at Oregon State University in the Design Engineering Lab. They investigate how social constructs like gender implicitly structure design theories, design cognition, and technology trajectories in service of building more equitable tech and infrastructure.

Christine Toh, James Madison University

I am an Assistant Professor in the Department of Engineering in the College of Integrated Science & Engineering at James Madison University. Prior to that, I was a faculty member at the University of Nebraska at Omaha in the College of Information Science & Technology. My research spans methods and topics across engineering a human-centered computing disciplines by examining the design theories, methods, and approaches that form the basis of modern design endeavors in engineering and technology design. I study the influence of philosophical and intellectual traditions on the way that we make, research, think, and talk about our modern built world. Design is a negotiation between the forces that shape individuals, organizations, and societies, and I have dedicated my scholarship to understanding these forces and their interaction to get us one stop closer to fulfilling the design discipline's promise of improving society.

Prof. Andy Dong, Oregon State University

Andy Dong is head of the Oregon State University School of Mechanical, Industrial, and Manufacturing Engineering and a professor of mechanical engineering. His research addresses strategy in the design and innovation of engineered products and systems.

Making Implicit Gender Bias Visible in Engineering Design: Developing a Curriculum Module for Implementing a Gender-Design Implicit Association Test

Abstract

This paper details the development and implementation of a sociotechnical curriculum module using a Gender-Design Implicit Association Test as an educational tool for engaging with implicit gendered associations in design thinking. We share learnings and materials from designing and implementing this module during a design workshop hosted at a 2025 design engineering conference. Workshop participants ($N = 13$) completed the Gender-Design IAT, followed by a short demonstration of a class session, and engaged in small-group discussions to reflect on their IAT experience and results. Using survey data, IAT test scores, and responses to small group discussion questions, we examined how participants engaged with design-relevant implicit bias content and whether the module motivated and facilitated this engagement. Preliminary results indicate that while the Gender-Design IAT was unfamiliar, as an educational tool it effectively stimulated reflection and discussion about gender bias in design among engineering design faculty, graduate, and undergraduate student participants. Curriculum and supplementary materials are openly shared to support future adaptation by engineering educators. Future work will explore how the module be implemented across different design engineering education contexts and institutions, using both qualitative and quantitative data to assess whether the learning objectives were met.

Introduction

Critical research in engineering education continues to advance, and calls into question, current understandings about how longstanding masculine gender dynamics and implicit gender bias negatively impact engineering education and practice[1,2,3,4,5,6]. Despite continued efforts by engineering educators to raise awareness of gender bias in engineering[5,7], developing and implementing meaningful, discipline-specific sociotechnical curriculum that addresses implicit gender biases remains a significant challenge.

Most engineering teaching faculty–even those who are enthusiastic about doing this work–receive little to no formal training or professional development in inclusive, let alone gender-inclusive, approaches to engineering design education[8]. This tension is exacerbated as higher-education institutions increasingly expand their undergraduate curricula to include coursework in ethics, diversity, and sociotechnical reasoning[9]. While this institutional shift represents important progress, engineering design faculty are often provided minimal institutional support–such as time and teaching resources–to implement best-practices for design-relevant sociotechnical content and curriculum development[10]. As a result, the responsibility and labor of addressing gender bias in design education is frequently placed on individual instructors without sufficient support and expertise [11].

To support faculty development and lower barriers for implementing design-relevant sociotechnical curriculum, we developed an open-source, adaptable teaching module that utilizes a Gender-Design Implicit Association Test (IAT)[12]. In contrast to generic IATs, this module leverages an *engineering design-relevant IAT* that examines associations between gender, product attributes, and work or home products. By situating implicit bias within a design-specific context, we argue the Gender-Design IAT makes implicit gender norms in design personally visible to engineering students. We also argue the value of the Gender-Design IAT is in its ability to create cognitive dissonance within students; this "generative tension" or productive discomfort, is pedagogically valuable as it can help prompt critical self-reflection about how gender norms manifest in design thinking and evaluation[13]. To examine the curriculum and Gender-Design IAT as a pedagogical tool, we piloted the teaching module in a design engineering workshop with engineering design faculty, doctoral, and undergraduate students.

Related Work

Engineering design education research widely recognizes design as a sociotechnical endeavor, where practice involves engaging with technical and social dimensions. Although gender norms have been shown to influence nearly every aspect of technological development–from shaping the design questions engineers ask, to whose user needs are translated into engineering specifications, to how product innovation is conceptualized[14,15,16,17,18]–gender is rarely treated as a critical variable in design beyond viewed as a demographic of consumers. In addition, dominant engineering culture, ideologies, and mindsets continue to marginalize social dimensions such as gender in engineering curricula and practice[19].

Previous pedagogical studies have sought to address gender bias through different ways such as creating an interactive fish management activity for students[5] and reframing implicit bias as an important professional skill to manage in first-year programs [4]. While these approaches have pedagogical value in raising awareness of implicit bias, existing studies have shown that simply informing or warning individuals about bias is often insufficient, since individuals tend to overlook, disregard, or downplay their own susceptibility to bias[20]. Engineering students, and educators, are no exception.

Mechanical engineering is a historically male-dominated and culturally masculine field, making engineering students particularly susceptible to reproducing male-normed biases throughout the design process[17,16]. Since most designers lack exposure to gender-inclusive engineering education, we argue they are unequipped to recognize how implicit gender biases manifest in design education and practice. This suggests a need for pedagogical approaches that make implicit gender bias personally visible and directly relevant to engineering practice.

To overcome current approaches to addressing gender bias, we looked to implicit social cognition literature, specifically at methods that trigger cognitive dissonance, which has been shown to raise

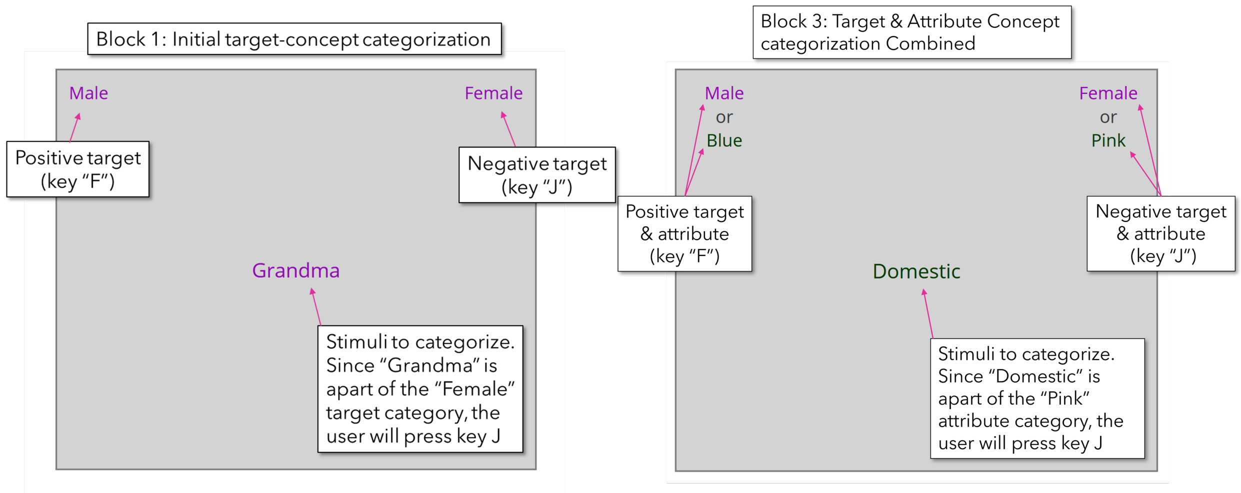


Figure 1: Illustrations from the Gender-Design IAT in single and combined concept categorization tasks.

awareness of implicit biases. Cognitive dissonance is a mental state where conflicting ideas or behaviors create psychological discomfort, which motivates the individual to engage in reflection, thus making implicit biases more visible[21,22]. Methods such as the Implicit Association Test has been shown to elicit cognitive dissonance in participants[23], but has rarely been adapted for domain-specific design contexts or used as a pedagogical instrument (rather than as a diagnostic measure)[24].

To address this, we adapted the Implicit Association Test (IAT) with the aim of creating a pedagogical tool that stimulated conversation, connection, and critical self reflection on how gender norms impact design thinking and decision-making. The Gender-Design IAT we developed, as shown in Fig. 1, measures the strength of participants' implicit associations between gender, products, and design-relevant product attributes[12], which we argue makes implicit bias visible *and* design relevant. The development of the Gender-Design IAT used in this study can be further explored in our prior research [12]. The purpose of this module was to examine the effectiveness of the implementation of the Gender-Design IAT in the context of an educational setting. In Figure 2, we provide the category labels and related stimuli used within the Gender-Design IAT.

For each participant, a D-score is calculated, which provides the individual with information about the direction and strength of their associations. The premise is that if two concepts are closely linked in the mind, participants will respond more quickly than when two concepts are less associated[25]. The goal of the Gender-Design IAT is to enable individuals to use their results and experience as a catalyst for critical self-reflection on how gender norms and their implicit associations impact their design thinking.

Research Objectives

Our main objective of this study was to examine the Gender-Design IAT as a pedagogical tool to help engineering students recognize and challenge their implicit gendered associations, with

IAT 1 Categories & Related Words

Categories	Category Types	Stimuli
Male	Target Category	Man, Son, Father, Boy, Uncle, Husband, Grandpa, Male
Female	Target Category	Woman, Daughter, Mother, Girl, Aunt, Wife, Grandma, Female
Blue	Attribute Category	Industrial, Innovative, Technical, Competitive, Tough, High-Performance, Powerful
Pink	Attribute Category	Domestic, Aesthetic, Stylish, Helpful, Flexible, Colorful, Handcrafted

IAT 2 Categories & Related Words

Categories	Category Types	Stimuli
Blue	Target Category	Industrial, Innovative, Technical, Competitive, Tough, High-Performance, Powerful
Pink	Target Category	Domestic, Aesthetic, Stylish, Helpful, Flexible, Colorful, Handcrafted
Work Products	Attribute Category	3D Printer, Toolbox, Steel-Toed Boots, Handheld Drill, Heat Gun, Soldering Iron, Beer Mug, Truck
Home Products	Attribute Category	Sewing Machine, Purse, Heels, Handheld Mixer, Hair Dryer, Hot Glue Gun, Cocktail Glass, Volkswagen Bug

Figure 2: Gender-Design IAT Categories and Words

particular attention to how masculinity is embedded in the pursuit of design innovation. Our focus on novice engineers is intentional as we believe greater awareness of implicit biases early on can help engineers develop strong sociotechnical understandings to navigate increasingly complex and globalized engineering problems and a fast-changing technological society.

Experiencing cognitive dissonance while taking the Gender-Design IAT can serve as an entry point for students and educators to acknowledge how culturally learned associations can manifest as gender-based biases in design cognition. This paper has two primary objectives that structured our workshop development and analysis:

1. Curriculum Design and Development: Design an adaptable sociotechnical curriculum module that integrates the Gender-Design Implicit Association Test (IAT) to support learners in recognizing and reflecting on implicit gender biases in engineering design contexts. Create public and shareable instructional materials to support adoption by engineering teaching faculty.

2. Implementation and Evaluation of Curriculum Design through Design Workshop: Examine the feasibility and effectiveness of the Gender-Design IAT module through its implementation in a design workshop through analyzing workshop participant survey responses, written reflections, and small group discussion data.

Curriculum Design & Development

To support our goal of creating an accessible teaching module that can be used in different first-year undergraduate engineering programs and engineering design courses, we designed this teaching module to be adaptable and feasible to implement, while staying aligned with ABET-guided learning outcomes relevant to fostering sociotechnical learning. In creating this curriculum we focused on lowering common barriers for educators like a lack of formal training

Level	Institution	Course	Example Lesson
Lower-division	Oregon State University *(R1 Public land-grant)*	ENGR 102: Intro to Design Engineering & Problem Solving	"Human Thinking (the Brain)" or "Intro to Design Thinking"
	James Madison University *(R2 Public)*	ENGR 112: Engineering Skills & Decisions	
	Harvey Mudd College *(Private SLAC)*	ENGR004: Intro to Engineering Design & Manufacturing	
Upper-division	Oregon State University	ME 382: Intro to Mechanical Design	"Whose Needs? Engineering Requirement Solicitation & Setting"
	James Madison University	ENGR 331: Design Thinking & Fabrication Methods	
	Univ. of Michigan *(R1 Public)*	ME 457: Front-end Design	

Figure 3: This chart provides an example of where this curriculum could be adopted into already existing ABET-accredited engineering design programs. Lesson example titles are provided based on existing units in course syllabi.

in gender or sociotechnical studies, lack of class time, and differences in institutional support and requirements around sociotechnical or ethics-focused coursework. We used a backwards design method to design the curriculum, which has been increasingly adopted by engineering educators to support student-centered learning in both lecture and lab environments [26,27]. Backwards design emphasizes defining desired learning outcomes first, followed by the development of learning assessments, activities, and assignments that support these learning outcomes[28].

Using this approach, we identified that our main meta-goal of developing a 50-minute teaching module was so that it could practically be implemented into existing undergraduate engineering design courses without requiring extensive curricular modifications. Recognizing that institutions often favor measurable student outcomes, we defined several key learning objectives related to implicit gender bias in design that are supported by low-stakes, formative assessments that allow instructors to evaluate student learning without adding significant grading or prep. The following section describes the module's learning objectives, assessment strategies, and lesson plan. We also highlight where the lesson plan can be modified and adapted by educators to best fit their learning environment and students.

Key Learning Objectives

Following the first step of the backwards design framework, we identified our learning objectives based on one of the sociotechnical-focused ABET student outcomes, namely outcome two, which requires students to apply engineering design to produce solutions that consider safety, public health, as well as social and cultural factors[29]. From here, we developed two Student Learning Outcomes (SLOs) based on the need evident in current courses and by engineering instructors[3] and specifically targeted gender bias because discussion of gender norms is often excluded in engineering education[8]. For a 50-minute instructional module, the student learning objectives (SLOs) were:

- **SLO1:** Students will increase their understanding of how implicit gendered associations can influence design thinking

- **SLO2:** Students will reflect on and build communication skills in expressing how social norms like gender, can shape design outcomes

Here, we used the Gender-Design IAT as a trigger for students to engage in reflection and build skills in verbal (or written) communication to be able to feel more equipped discussing how social norms like gender impact design cognition and outcomes. Fig. 3 shows an example of existing undergraduate courses, from first-year engineering to upper division design classes, where we believe this curriculum could be integrated in to strengthen the courses' learning outcomes. We note the institution type and research classification, which may indicate how teaching duties are allocated among faculty. The remainder of this section describes the pedagogical strategies and materials used in the teaching module to meet our SLOs.

Modular Lesson Plan & Activities

The lesson plan and course materials were created to be adapted into existing undergraduate engineering courses that cover topics of product design and manufacturing, design thinking, inclusive and equitable engineering, ethics, engineering education, and sociotechnical engineering topics. Because of this variation, we designed a modular lesson plan in hopes that instructors will adapt it based on class size, duration, and instructional context. Fig. 4, describes the general outline with interchangeable components that instructors can opt into or out of depending on class constraints and learning objectives. The module is structured to begin with individual exposure to the topic of implicit gender bias with the goal of moving toward a collective understanding of how implicit biases of social norms like gender can influence engineering design.

Lesson Plan Sequence	Main Activity (Recommended)	Optional Add-Ins or Alternatives	Time	Notes
Pre-lecture Prep	Students complete the Gender-Design IAT individually • *Instructor must calculate and organize IAT scores*	Alternate or additional assigned readings or videos on implicit bias, gender, and design.	15-25 min	IAT is administered online via Qualtrics
Introduction & Framing	Instructor leads introduction to implicit bias and learning objectives for the class	Poll for anonymous check-in about implicit bias, or short think-pair-share	5-10 min	Large lecture formats might favor polling (i.e., Kahoot, slido, polling tool)
Reading Review Activity	Instructor leads brief recap or discussion of pre-lecture readings. Optional: summarize main points from articles	Large or small-group discussion activity (i.e., Questions & Quotes), written reflection, or general class Q&A	5-10 min	Can be skipped if no readings were assigned or if time is limited and in large-lecture hall
IAT Interpretation & Score Reveal	Instructor introduces IAT scoring logic and interpretation (before revealing results)	If not, use anonymized sample scores instead of student/personal scores	5 min	Try not to skip this step, important for rest of lecture
Small Group Discussions	Guided discussion of IAT experience and design implications	Structured worksheet for self-reflection, think-pair-share	15-25 min	Best with < 35 students or breakout rooms
Reflection & Feedback	Exit ticket describing the 'muddiest point' or self-reflection	Verbal wrap up or discussion board post (on Canvas)	5 min	Small-low stakes formative assessment, useful feedback for instructor

Figure 4: Example lesson plan for a 50-minute lecture with pre-lecture assignments. Table shows learning activities and relevant student learning objectives targeted in each activity. If instructing a class session longer than 75 minutes, consider integrating taking the IAT in class together; allot 20 minutes for this task.

Introduction and Framing

It is important to remember that gender bias and stereotypes remain a critical and heavy topic in engineering education and practice. As such, we paid explicit attention to framing implicit cognitive biases as inherent to human cognition or "habits of mind"[30], rather than framing implicit bias as an individual moral flaw or hidden trait[31]. This approach avoids shaming and blaming individuals for having biased thoughts, and instead focuses on helping participants understand that implicit gender biases are a product of being socialized in society; this perspective also helps students shift toward understanding their blindspots. This is essential as a professional to develop effective and equitable engineering solutions[4,32]. To gauge where students' initial understandings of implicit bias are and their reactions to taking the Gender-Design IAT, an instructor can host an anonymous poll or peer think-pair-share.

Reading Review Activity

We recommend students complete a short reading on implicit biases prior to class. Instructors can choose an appropriate and relevant reading for their students from a list of articles available in Appendix A. For example, assigning a dense scholarly article on the theory of implicit biases is likely not helpful for first-year undergraduates. Instead, an instructor can assign a non-academic article such as Professor Alec Gallimore's rallying call-to-action op-ed that demands for more sociotechnical engineering education and bias mitigation[32]. How instructors engage students with the pre-lecture reading is intentionally left open, since this activity will depend on class size, physical or virtual constraints, and student exposure to group discussions. Following the reading review activity, the instructor should emphasize several key principles: 1) implicit associations are fundamental to human cognition[24]; 2) engineers, like all individuals, carry biases influenced by social and cultural contexts[32]; and 3) gender norms operate as embedded social structures that subtly influence design thinking and processes[33,16]. These principles are intended to destigmatize and demystify bias while highlighting its fundamental role in technical decision-making.

IAT Interpretation and Score Reveal

Up until this point, students do not know their IAT scores. Before students view their individual IAT results, the instructor should lead a brief overview of the IAT scoring method, highlighting that scores reflect the relative reaction time differences when pairing congruent versus incongruent concepts [24]. Explaining this before disclosing students' scores helps support the interpretation of individual results. See Appendix A of how our lecture slides presented this material. To display students' anonymized IAT scores, the instructor should have processed the IAT Qualtrics data file using the open-source web app as described in the introductory sections.

Small Group Discussions

For this part of the lesson, students are organized into small groups to cooperatively process and debrief their IAT scores through discussion questions. Small-group discussions are known to help participants, who might not otherwise participate in large-group discussions, have space to build communication and self-reflection skills with others[34].Instructors should tailor their discussion questions depending on engineering exposure and experience of students. If working with first-year students, for example, many do not have extensive professional engineering experience; it might be more helpful and useful to include questions that create space to discuss the act of taking the IAT such as: *How did you feel while taking the Gender-Design IAT?* or *What do you* *think the Gender-Design IAT is about?*, and *If you're comfortable sharing your IAT score, did it match your beliefs about gender?* If small group discussions are not possible for whatever reason, we recommend a structured worksheet for individuals to fill out followed by a think-pair-share.

Assessment of Learning

To assess student learning, instructors can choose from a variety of low-stakes formative assessments. The lesson plan includes several examples of what this could look like. For example, students can fill out an 'exit ticket' (whether filled out online or on a slip of paper), complete a short written reflection prompt, or answer follow-up questions in a discussion board post. These assessments are also intentionally left open so instructors can adapt this to how they best understand student engagement, awareness and perception of gender bias in design, and openness discussing sociotechnical issues.

Implementation & Evaluation of Curriculum through a Design Workshop

To examine teaching feasibility and impact of the curriculum and Gender-Design IAT as educational tools, we piloted the module through a workshop at the 2025 American Society of Mechanical Engineers (ASME) International Design Engineering Technical Conference (IDETC). The workshop learning objectives were motivated by the lack of engineering design-relevant sociotechnical curriculum and pedagogical tools publicly available for engineering design faculty[19,35]. While the in-class module focuses on student learning, the workshop aimed to do three things:

1. Introduce engineering educators and researchers to the Gender-Design IAT as a pedagogical tool,
2. Demonstrate how implicit associations can be taught and discussed within a design context, and
3. Gather feedback on the curriculum's effectiveness and adaptability.

In the following section we describe the structure of the workshop, the participants, modified curriculum and supplemental materials, and data collection methods.

Workshop Venue & Recruitment

IDETC provided an ideal venue to pilot this curriculum because it afforded a timely opportunity to engage with engineering faculty and graduate students who are actively engaged in engineering design research and education in a relatively controlled setting. This setting enabled pilot testing of the curriculum with a knowledgeable audience capable of providing informed and helpful pedagogical feedback. To recruit participants for the workshop, we sent an email advertisement to the ASME Design Theory and Methodology conference listserv the week before IDETC conference registration opened. The workshop was free and open to all IDETC attendees.

Participants

Although 25 participants registered, 13 participants showed up in-person and completed the workshop. Participants represented engineering design faculty and doctoral students currently

Workshop Segment	Time (min)	Teaching & Learning Activities
Intro to workshop	10	Design warm-up (optional), Names circle, Review learning outcomes
Pre-workshop survey	10	Administer online (e.g., Qualtrics) or in-print
Gender-Design IAT	30	Participants take the IAT on their computer
Break 1	*5-10*	
Mock Class Demo	50	Review learning objectives, in-class reading recap discussion, review how IAT scores are calculated, small-group discussions
Break 2	*5-10*	
Panel Discussion	35	Brought in three academic and industry researchers to discuss gender bias, design cognition, design and AI in industry
Post-workshop survey	5-10	Distribute take-home materials (zine, reading list)

Table 1: Three-hour workshop structure with teaching and learning activities outlined for each hour-long part

engaged in engineering design research and teaching. 5 participants identified as teaching faculty (tenured, tenure-track, and non-tenure track) who instruct courses on engineering design including the technical fundamentals of engineering, ethics and societal impact, and professional communication. 5 participants were doctoral students and 2 participants were undergraduate students. All participants have varying levels of academic and industry experience within the field of mechanical engineering. Of these participants, 3 identified as teaching assistants or involved in academic tutoring. Of those who reported gender and race, 8 identified as women, 2 identified as non-binary, 3 identified as men; 9 identified as white, 4 identified as Asian, Black, and multiracial. 5 participants identified as living with a learning or health-related disability.

Workshop Facilitation

The three-hour workshop, titled "How Implicit Associations of Social Norms Can Be Operationalized in Engineering Design & Education" consisted of three 50- minute parts: (1) a workshop introduction and taking the Gender-Design IAT, (2) a mock class demonstration adapted from the in-class module with small group discussions, and (3) a facilitated panel discussion with industry and research experts, as shown in Table 1. Each part of the workshop was designed to replicate components of the classroom curriculum. Participants completed pre-workshop and post-workshop surveys to understand the effectiveness of the teaching module. The survey design was adapted from Gill et al. (2010), who sought to cultivate awareness of implicit bias and its negative consequences in patient care for medical students through the IAT[36]. Using this as a template, our pre- and post-survey items, as shown in Appendix A, were designed to map to workshop research objectives. The pre-workshop Likert-scale question series sought to capture baseline perceptions about impacts of gender bias in engineering design work and measure personal awareness of one's own implicit biases. Post-workshop Likert-scale questions included repeated questions from the pre-workshop survey and additional questions to capture immediate feedback of the Gender-Design IAT teaching module.

Predicting that few participants had direct exposure to Implicit Association Tests, registered participants received a pre-workshop email describing the workshop goals and logistics. To familiarize participants with the mechanics of the IAT, participants were provided with a link to the Flower-Insect IAT from Project Implicit, allowing them to engage with an IAT without priming them on the workshop's content in advance.

Once the in-class module demonstration was completed, workshop participants were assigned to 4 small groups for a guided discussion on their experiences with the IAT and the instructional module. Discussion facilitators were recruited one to two months prior to the workshop and were specifically selected for their experience in small-group dialogue facilitation and familiarity with gender bias in the engineering design process. Each facilitator was responsible for guiding the groups through the discussion question prompts, recording main themes from these discussions, and corresponding direct quotes from participants that characterize these themes. Participants rated the facilitators a median rating of 4 out of 5 in creating an open environment for discussion. The small group discussion questions were tailored for the specific audience of the workshop and included the following:

1. How did you feel while taking the Gender-Design IAT? Surprised? Frustrated? Overwhelmed? Skeptical?
2. If you're comfortable sharing your IAT score, did it match your self-perception when it comes to gender and design?
3. Were social norms ever discussed in your engineering design education or practice?
4. Can you remember a time you saw gender bias manifest in design or in your own work or other's work?
5. What's one takeaway or question you're leaving this discussion with?

After the small group discussions, the last part of the workshop featured a panel discussion with three academic and industry experts to discuss their own career trajectories towards studying gender and cognitive biases, how the rapid rise of AI in design can exacerbate biases, and what is next for the field of engineering design. After a lively panel, exit surveys were passed out and participants were left with take-home materials that included a zine based on the workshop material. After the workshop concluded, a follow-up email was sent with links to all curriculum development materials including the reading list, slides, a link to the Qualtrics-compatible Gender-Design IAT, and a digital copy of the zine (see Appendix A).

Results & Discussion

We start by sharing our own reflections and recommendations as engineering educators who designed and facilitated this workshop. We then report findings from our qualitative analysis of small group discussions and workshop survey data to provide more insight into the effectiveness of using the Gender-Design IAT as an entry point for sociotechnical learning in engineering design curriculum. We hope these reflections and results provide useful insights for faculty interested in adapting and implementing this module into their own courses.

Prioritize a Supportive Learning Environment Over Content Expertise

Although we, as the designers and facilitators of the workshop, have expertise in engineering design, gender studies, and implicit social cognition research, implementing the curriculum *does not* require instructors to have extensive expertise in these areas. We feel a primary takeaway is that successful implementation of the module depends far more on an instructor's ability to create a supportive, active learning environment and to facilitate dialogue around potentially uncomfortable topics. While we recommend that instructors have basic language and familiarity with social norms and implicit bias, the curriculum itself is intentionally designed such that much of the learning happens through class activities like taking the Gender-Design IAT, the assigned readings, and the small- and large-group discussions. From our pilot implementation, we spent approximately 15 minutes of class time lecturing, which also included reviewing the learning objectives, briefly recapping the readings, and explaining how IAT scores are calculated. The remainder of the session focused on participant engagement, reflection, and discussion. Because of this, we believe the instructor's facilitation skills are more critical than serving as a content expert. This positions the curriculum well for educators who may not have in-depth sociotechnical training and aligns with inclusive pedagogical approaches that move away from the "banking model" of education and instead emphasizes meaning-making, critical reflection, and dialogue[37].

Classroom Logistics and Format Considerations

As with all teaching, physical room layout and class session length can influence the teaching and effectiveness of a module. Due to the interactive and hands-on nature of the curriculum, we believe that a smaller class (fewer than 30-35 students) will likely be more conducive to group discussions; however, there are a number of feasible and effective teaching strategies–such as think-pair-share activities, individual reflection prompts, and small group discussions– that can support meaningful engagement even in larger lecture formats, which is likely the class format for first-year undergraduate engineering courses[38]. Utilizing various active learning strategies also provides an outlet for students to connect in-class learnings to their lived experiences and encourages different avenues for students to participate in the classroom. To make sure that students can have small group discussions, we also recommend your classroom layout has modular seating or the ability for students to gather into small groups. If the curriculum is implemented synchronously online, creating breakout rooms provides an effective substitute for in-person small group discussions.

In terms of timing, we found the teaching module is best suited for longer class periods (e.g., 75 minutes or more). While we were able to implement a 50-minute module during the workshop, the timing was tight and may require that some activities, such as the reading recap or small group discussions, be shortened to make sure instructors stay within their allotted class session length. We also note that we allotted 30 minutes for small group discussions during the workshop as the dialogue facilitation was intended for faculty and graduate students, or professionals to reflect on their own experiences in engineering education and industry in relation to implicit gender biases. For undergraduates, the small-group discussion may naturally be shorter, as many do not have years of engineering experience. These small-group discussions may focus more directly on students' personal experiences taking the Gender-Design IAT.

Managing Data Processing and the Qualtrics-based IAT

Whether students take the Qualtrics-based IAT before class or during class (for those who have class sessions longer than 75 minutes), the instructor must process the IAT data in order to obtain the participants' IAT scores. This requires access to Qualtrics and the ability to process the data in R Studio. Before opting to run this module, check if your institution has a Qualtrics license. While the R script and instructions for uploading the Qualtrics data file into the IAT scoring module are provided, we recognize this requires extra work on the instructor's end because this process is not automated. We recommend instructors practice processing the data before the class session to ensure the R script and open-source web app data scorer[39] module are properly working. Administering the Gender-Design IAT in-class has its advantages, but requires that instructors allot at least 20 to 30 minutes of class to administer it and help troubleshoot the data processing if needed. One advantage of conducting the IAT in-class is that the experience of taking the IAT is fresh in participants' minds and naturally leads to discussion as students seek to debrief and process their experience and results. However, because the IAT is cognitively taxing, we recommend a break between the IAT and the in-class teaching module.

Survey Results and Participant IAT Scores

Workshop participants completed a pre-workshop and exit-survey to self-report awareness of implicit gender bias in addition to their perceptions of the effectiveness of the Gender-Design IAT and curriculum as pedagogical tools for engineering education. Survey items were rated on a 5-point Likert scale with 1 representing "Strongly Disagree" and 5 representing "Strongly Agree". Participant IAT scores were also analyzed and plotted using R Studio. For the full survey instrument, see Appendix A. To observe if there were short-term shifts in participants'

Pre- & Post-Workshop Survey Questions		Median Rating Change (Δ)
1	It is likely that I have certain biases when making technical engineering decisions of which I am unaware of	+1
2	I have a difficult time noticing how certain unrecognized assumptions or preferences can influence my design decisions.	0
3	I tend to make design decisions quickly without much reflection on how my own perspectives might be influencing my design work.	-0.5
4 (pre) 5 (post)	I am confident in my ability to identify and address situations where my potential biases might affect design decisions.	+1
6	Individuals can become aware of their implicit biases.	0
7	Individuals can learn to manage their implicit biases.	0
8	Individuals can eliminate their implicit biases.	- 0.5

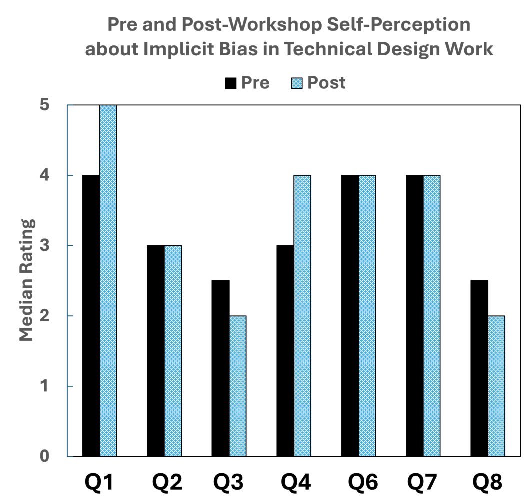


Figure 5: Pre- and Post-Workshop self-perception questions about implicit bias.

self-perceptions of implicit bias following the workshop, we compared pre- and post-workshop survey responses as shown in Fig. 5. Participants reported an increase in awareness that they are likely to hold biases when making technical engineering decisions of which they are unaware of, with the median response increasing from 4 to 5. Similarly, participants also reported an increased confidence in their ability to identify and address situations where potential biases might affect design decisions, with the median rating increasing from 3 to 4. In contrast, we saw a

	Post-Workshop Survey Question	Median Rating
11	The IAT made me think differently about how gender influences design cognition	3
12	I see value in using the IAT as a teaching or reflection tool with engineering students or colleagues	4.5
13	I would like to explore ways to improve or adapt the IAT for future use	4
14	The teaching demo effectively showed how to incorporate the IAT into a classroom setting or training setting	4
15	I gained new ideas for activities or discussions I could use in my own teaching or research	4
16	I plan to use the IAT (or a similar tool) in my classroom, lab, or research	3
17	I plan to seek out additional literature or resources to continue learning about bias in engineering design	4

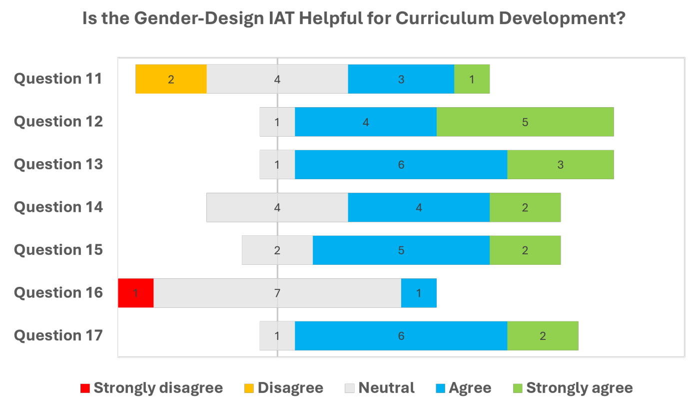


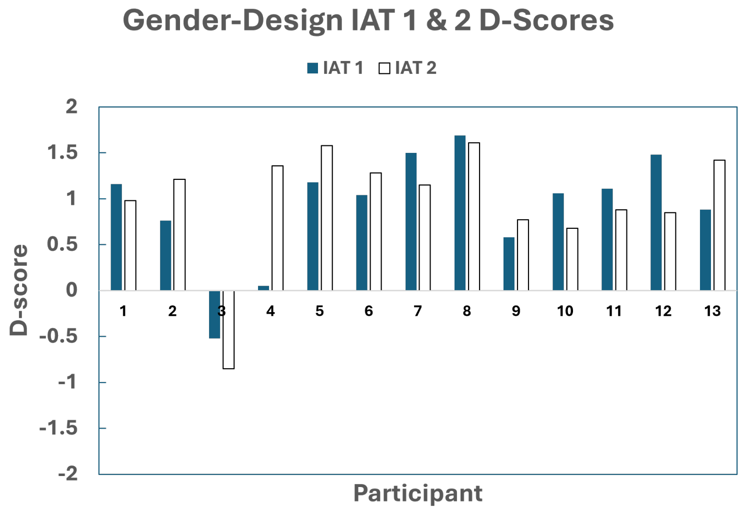
Figure 6: Is the Gender-Design IAT an Effective Pedagogical Tool?

slight decrease in agreement with the statement that individuals can eliminate their implicit biases, with the median rating decreasing from 2.5 to 2. This shift might indicate that participants increasingly viewed implicit biases as a fundamental feature of human cognition that is shaped by broader social and professional group norms (i.e., engineering culture), rather than as an individual trait that can or should be eliminated.

To further assess the perceived effectiveness and feasibility of the teaching module, post-workshop survey questions 11-17 focused on participants' perspectives regarding the value of the Gender-Design IAT and its potential integration into engineering education (see Fig. 6. Overall, participants saw value in using the IAT as a teaching or reflection tool with engineering students or colleagues, reporting a median rating of 4.5. Similarly, participants were open to exploring ways to improve or adapt the IAT for future use. While participants found the teaching demo valuable, as it provided one way to incorporate the IAT into a classroom setting, participants reported a lower level of agreement with planning "to use the IAT in my own classroom, lab, or research", with a reported median rating of 3.

To calculate participants' IAT scores, the IAT Qualtrics data file was processed through the IAT D-scorer module developed by Cui et. al (2021)[39]. Higher positive D-scores for IAT 1 indicates stronger associations between masculine gender with innovative-functional product attributes and feminine gender with aesthetic-domestic product attributes. Higher positive D-scores for IAT 2 indicate stronger associations between innovative-functional product attributes with work-related products and aesthetic-domestic product attributes with home-related products. The mean D-score for IAT 1 was 0.92 (SD = 0.58) and the mean D-score for IAT 2 was 0.99 (SD = 0.61). All participants' D-scores, as shown in Fig. 7 were positive except for one participant who exhibited a negative D-score for both IATs. Negative D-scores indicate a stronger association between feminine gender with innovative-functional product attributes and a stronger association between home-related products and innovative-functional product attributes. In interpreting D-scores, the literature suggests that D-scores ≤ 0.15 indicate a "slight preference" for hypothesis-confirming pairings (i.e., male gender with innovative-functional product attributes), D-scores ≤ 0.35 indicate a "moderate" preference, and D-scores ≥ 0.65 indicate a "strong" preference[24].

Learnings from Small-Group Discussions



IAT 1 D-score > 0.65)	IAT 2 D-score > 0.65
Strong **Male** + **Innovative (Blue)** / **Female** + **Aesthetic (Pink)** association	Strong **Innovative (Blue)**+ **Work/ Aesthetic (Pink)** + **Home** association

No effect (-0.15 ≥ D-score ≤ 0.15)

IAT 1 D-score > -0.65	IAT 2 D-score > -0.65
Strong **Female** + **Innovative (Blue)** / **Male** + **Aesthetic (Pink)** association	Strong **Aesthetic (Pink)**+ **Work/ Innovative (Blue)** + **Home** association

Figure 7: IAT 1 and IAT 2 D-scores per participant with D-score interpretation tables.

Here we present insights gained through open-coding participant small group discussions captured by the workshop facilitators. Facilitators acted as instruments of knowing during the discussion by recording key themes that emerged in these informal group discussions. Thus, qualitative data produced through this process represented dominant discussion points as interpreted by facilitators who are well versed in this topic. In addition, the first author consolidated these discussion themes across groups to identify common themes across discussion groups. Direct quotations as recorded by group facilitators have been edited to remove false starts and crutches of speech.

From this analysis, it was clear that workshop participants were eager to discuss the Gender-Design IAT, their IAT scores, and broader experiences and observations of gender bias in engineering contexts. We found that participants were generally open to the IAT as a reflective tool and described that it gave an opportunity to examine how normative implicit gender associations may shape their own thinking. At the same time, participants found the IAT cognitively taxing and shared confusion about the selection of IAT stimuli and category labels.

One major theme was a wide acceptance and understanding that the Gender-Design IAT intentionally provoked normative, binary categorizations of gender as a way to make implicit gender bias visible. One participant, unsurprised by this, said that, *"I expected that I would have bias, and I do"*; another participant shared that they *"probably flew through the normative groupings"* on the IAT when pairing masculine gendered nouns with innovative-functional product attributes. Participants also referenced their personal upbringing to contextualize their responses to the IAT, noting that early socialization and cultural norms may shape automatic, unintentional associations, despite efforts to resist those stereotypes. One participant reflected that although they actively try to break gender norms, they grew up in a conservative household with strong normative views of gender, which may have influenced how their brain, even today, automatically categorized concepts during the IAT.

Given that many participants were design researchers themselves, it was expected that a second theme would involve critical reflection on the IAT's construct validity, particularly regarding the selection of category labels ("Blue" and "Pink") and related stimuli. One participant shared that, *"With the pink and blue categories there was nothing tying the word to the color name. I struggled so much with why would this one be pink versus blue"*. This feeling and critique highlights an important aspect of the Gender-Design IAT in that it asks participants to pair abstract category labels such as "Blue" and "Pink" with product attributes like *Innovative* and *Stylish*, which increased cognitive load for some participants. The choice of "Blue" and "Pink" category labels, while abstract, was intentionally chosen to reflect normative associations of gender (as related to color) without alerting the participants of the study's conceptual framing[12]. In addition, the participants' high D-scores indicated that even with more abstract category labels like "Blue" and "Pink", a strong implicit association was still observed.

One discussion group also argued that more scaffolding was needed when framing the IAT (such as explaining how scores are calculated more). They felt that the IAT's abstractness could diminish its effectiveness. However, while they noted that the IAT is not a perfect test, they acknowledged that the test made them think about implicit gendered associations within a design context. The IAT prompted deeper discussion about how socially constructed gender associations become normalized within design practice, which was a primary goal of this research study.

After participants discussed the IAT, participants were asked to share experiences of gender bias in design and how social norms were discussed in their engineering education. Across all small group discussions, participants noted that education on how social norms impact engineering were almost never discussed (or formalized) in their engineering education, professionalization, and training as faculty members and doctoral researchers. One small group noted the irony that although ABET criteria requires that students engage with the social dimensions of engineering, it's often covered superficially or sidelined to make room for more technical content because there are no quantitative metrics to prove this; as a result sociotechnical content is often reduced to a one-off lectures in capstone project courses, for example. Many noted the numerous consequences of this in their own design work and plethora of existing gender-biased designs. One participant explained how the lack of training of user-centered design makes the expectation of them to design equitable programs a personally frustrating experience. They do not lack technical merit, but they have not been exposed sufficiently to user-centered design principles to be the expert that develops these more inclusive program interfaces.

Conclusion

In this paper, we introduced the Gender-Design Implicit Association Test as a pedagogical tool to stimulate sociotechnical learning and support the integration of design-relevant implicit gender bias content into undergraduate engineering design curricula. We piloted the teaching module in an engineering design conference workshop with faculty, doctoral students, and undergraduates to examine its feasibility and value as a pedagogical intervention. Our findings suggest that the Gender-Design IAT provides a meaningful and effective entry point for engaging participants in critical reflection on how implicit gender biases and gender norms shape design cognition and the ways we talk about gender in engineering. By making implicit associations personally visible and design-relevant, this work offers educators a practical and adaptable approach for facilitating deeper sociotechnical learning and connections in engineering design education. Future work will focus on examining how this module supports learning across different classroom contexts and student populations. We also plan to develop empirical evidence about instructors who implement the curriculum in their own teaching practice. All materials used in the teaching module (i.e., lesson plan slides, IAT slides, reading list, discussion questions) can be found in the appendices.

Acknowledgments

We would like to thank the workshop facilitators for their time and support in implementing this workshop. We thank the workshop participants for providing their thoughtful and honest feedback.

References

[1] Andrea Haverkamp, Michelle Bothwell, Devlin Montfort, and Qwo-Li Driskill. Calling for a Paradigm Shift in the Study of Gender in Engineering Education. *Studies in Engineering Education*, 1(2):55, February 2021. ISSN 2690-5450. doi: 10.21061/see.34. URL `https://www.seejournal.org/article/10.21061/see.34/`.

[2] Chelsea Onyeador, Shannon Gilmartin, Sheri Sheppard, Gloriana Trujillo, and Carol Muller. Adding Diversity and Culture to the Engineer's Toolkit: Evaluating a Unique Course Option for Engineering Students. In *2018 ASEE Annual Conference & Exposition Proceedings*, page 29753, Salt Lake City, Utah, June 2018. ASEE Conferences. doi: 10.18260/1-2--29753. URL `http://peer.asee.org/29753`.

[3] Andrew Gillen and Daniel Fisher. Exploring the Unconscious in Engineering Design Education: A Psychoanalytic Approach. In *2025 ASEE Annual Conference & Exposition Proceedings*, page 56547, Montreal, Quebec, Canada, June 2025. ASEE Conferences. doi: 10.18260/1-2--56547. URL `http://peer.asee.org/56547`.

[4] Jeffrey Fergus and Jessica Bowers. GIFTS: Framing Understanding Implicit Bias as a Professional Skill to First-Year Students. In *2023 ASEE Annual Conference & Exposition Proceedings*, page 43796, Baltimore , Maryland, June 2023. ASEE Conferences. doi: 10.18260/1-2--43796. URL `http://peer.asee.org/43796`.

[5] Presentacion Rivera-Reyes, Raymond Edward Boyles, and Oenardi Lawanto. Offsetting Gender Bias in Engineering: Gender Equity Internet Controlled Fish Farm Curriculum Activity. June 2012. ISSN: 2153-5965.

[6] Dr Claire L McCullough. Implicit Association Test as an Indicator of Gender Bias in Computer Fields. 2014.

[7] Claire Lynne McCullough P.E. Problem-based learning as a tool in addressing gender bias. In *2015 ASEE Annual Conference & Exposition*, number 10.18260/p.24592, Seattle, Washington, June 2015. ASEE Conferences. https://peer.asee.org/24592.

[8] Kacey D. Beddoes. Feminist scholarship in engineering education: Challenges and tensions. *Engineering Studies*, 4(3):205–232, 2012. doi: 10.1080/19378629.2012.693932.

[9] R.A. Miller and L.E. Struve. "heavy lifters of the university": Non-tenure track faculty teaching required diversity courses. *Innov High Educ*, 2020.

[10] Jenifer Blacklock, Kathryn Johnson, Randy Cook, Natalie Ann Plata, and Stephanie Claussen. Faculty Interpretations of Sociotechnical Thinking in their Classrooms: Techniques for Integration. July 2021.

[11] April M. Schueths, Tanya Gladney, Devan M. Crawford, Katherine L. Bass, and Helen A. Moore. Passionate pedagogy and emotional labor: students' responses to learning diversity from diverse instructors. *International Journal of Qualitative Studies in Education*, 26(10):1259–1276, November 2013. ISSN 0951-8398, 1366-5898. doi: 10.1080/09518398.2012.731532. URL `http://www.tandfonline.com/doi/abs/10.1080/09518398.2012.731532`.

[12] Samantha Kang, Christopher A. Sanchez, and Andy Dong. Developing the gender-design implicit association test: A tool for understanding how implicit gender bias shapes design cognition. volume Volume 4: 22nd International Conference on Design Education (DEC); 30th Design for Manufacturing and the Life Cycle Conference (DFMLC); 37th International Conference on Design Theory and Methodology (DTM) of *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, 08 2025. doi: 10.1115/DETC2025-169300. URL `https://doi.org/10.1115/DETC2025-169300`.

[13] Dean Nieusma. Conducting the instrumentalists: a framework for engineering liberal education. *Engineering Studies*, 7(2-3):159–163, 2015. doi: 10.1080/19378629.2015.1085060.

[14] Wendy Faulkner. The power and the pleasure? a research agenda for 'making gender stick' to engineers. *Science, Technology, & Human Values*, 25(1):87–119, 2000.

[15] Judy Wajcman. *Feminism Confronts Technology*. Penn State Press, 1991.

[16] Caroline Criado Perez. *Invisible Women: Data Bias in a World Designed for Men*. Abrams Press, New York, 2019. ISBN 9781419735219.

[17] Anastasia M. Schauer, Hunter Schaufel, Margaret Nunn, Noah D. Kohls, and Katherine Fu. Thinking beyond the default user: The impact of gender, stereotypes, and modality on interpretation of user needs. *Journal of Mechanical Design*, 146(5):051403, 01 2024. doi: 10.1115/1.4064263.

[18] Philippe Doneys, Kyoko Kusakabe, Evelyn F. Wamboye, Rebecca Elmhirst, Arul Chib, and Joyee Shairee Chatterjee. Gender, technology and development: reflections on the past, and provocations for the future. *Gender, Technology and Development*, 26(3):285–294, 2022. doi: 10.1080/09718524.2022.2153459.

[19] Erin Cech. *The (Mis)Framing of Social Justice: Why Ideologies of Depoliticization and Meritocracy Hinder Engineers' Ability to Think About Social Injustices*, chapter 4, pages 67—84. Springer International Publishing, 2013. doi: 10.1007/978-94-007-6350-0_4.

[20] Dennis S. Mileti and Paul W. O'Brien. Warnings during disaster: Normalizing communicated risk. *Social Problems*, 39(1):40–57, 1992. ISSN 00377791, 15338533.

[21] Elliot Aronson. The theory of cognitive dissonance: A current perspective. In Leonard Berkowitz, editor, *Advances in Experimental Social Psychology*, volume 4 of *Advances in Experimental Social Psychology*, pages 1–34. Academic Press, 1969. doi: 10.1016/S0065-2601(08)60075-1.

[22] Bodenhausen Galen V. Gawronski Bertram. Associative and propositional processes in evaluation: an integrative review of implicit and explicit attitude change. *Psychological Bulletin*, 132(5):692–731, 2006. doi: 10.1037/0033-2909.132.5.692.

[23] Anthony G. Greenwald, Nilanjana Dasgupta, John F. Dovidio, Jerry Kang, Corinne A. Moss-Racusin, and Bethany A. Teachman. Implicit-bias remedies: Treating discriminatory bias as a public-health problem. *Psychological Science in the Public Interest*, 23(1):7–40, 2022. doi: 10.1177/15291006211070781.

[24] A. G. Greenwald, D. E. McGhee, and J. L. K. Schwartz. Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, 74(6):1464–1480, 1998. doi: https://doi.org/10.1037/0022-3514.74.6.1464.

[25] Brian A. Nosek, Anthony G. Greenwald, and Mahzarin R. Banaji. Understanding and using the implicit association test: Ii. method variables and construct validity. *Personality and Social Psychology Bulletin*, 31(2): 166–180, 2005. doi: 10.1177/0146167204271418.

[26] Klaus Schmidt Jaby Mohammed and Jeritt Williams. Designing a new course using backward design. In *2022 ASEE Annual Conference & Exposition*, number 10.18260/1-2–41806, Minneapolis, MN, August 2022. ASEE Conferences. https://peer.asee.org/41806.

[27] Karen Elizabeth Eifler Timothy A. Doughty Daniel Anderson Ken Lulay P.E., Heather E. Dillon and Jose Israel Bastida De Jesus. Increasing engagement in materials laboratory with backward design and quadcopters. In *2017 ASEE Annual Conference & Exposition*, number 10.18260/1-2–28517, Columbus, Ohio, June 2017. ASEE Conferences. https://peer.asee.org/28517.

[28] G. P. Wiggins and J. McTighe. *Understanding by design*. Association for Supervision and Curriculum Development., 2005.

[29] ABET. Criteria for accrediting engineering programs, 2025-2026. Technical report, ABET, 2025. URL `https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2025-2026/`.

[30] Jennifer Sheridan, Manuela Romero, Mary E. Fitzpatrick, Christine Fabian Bell, Eve Fine, Carmen Juniper Neimeko, and Katherine Fallon. Helping Engineering Student Organization Members "Break the Bias Habit". April 2019.

[31] Javeed Sukhera, Alexandra Milne, Pim W. Teunissen, Lorelei Lingard, and Chris Watling. The Actual Versus Idealized Self: Exploring Responses to Feedback About Implicit Bias in Health Professionals. *Academic Medicine: Journal of the Association of American Medical Colleges*, 93(4):623–629, April 2018. ISSN 1938-808X. doi: 10.1097/ACM.0000000000002006.

[32] Alex D. Gallimore. It's time for engineering to be equity-centered. *Inside Higher Ed*, 2021.

[33] Joan Acker. Hierarchies, jobs, bodies: A theory of gendered organizations. *Gender & Society*, 4(2):139–158, 1990.

[34] Philip H. Pollock, Kerstin Hamann, and Bruce M. Wilson. Learning Through Discussions: Comparing the Benefits of Small-Group and Large-Class Settings. *Journal of Political Science Education*, 7(1):48–64, February 2011. ISSN 1551-2169. doi: 10.1080/15512169.2011.539913.

[35] Desen S. Özkan. Sociotechnical curricular approaches for a culture of engagement in engineering: students navigating power and equity. *Engineering Studies*, 0(0):1–26, 2025. doi: 10.1080/19378629.2025.2556386.

[36] Anne Gill, Britta Thompson, Cayla Teal, Rachel Shada, Ernest Fruge, Gracielia Villarreal, Cindy Patton, and Paul Haidet. Best intentions: Using the implicit associations test to promote reflection about personal bias. *MedEdPORTAL*, 6:7792, 2010. doi: 10.15766/mep_2374-8265.7792. URL `https://www.mededportal.org/doi/abs/10.15766/mep_2374-8265.7792`.

[37] Nana Osei-Kofi. Feminist Approaches to Social Justice Education: The Role of Faculty Development. *Feminist Formations*, 30(3):160–171, 2018. ISSN 2151-7371. doi: 10.1353/ff.2018.0045. URL `https://muse.jhu.edu/article/705532`.

[38] Kimberly D. Tanner. Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity. *CBE—Life Sciences Education*, 12(3):322–331, September 2013. ISSN 1931-7913. doi: 10.1187/cbe.13-06-0115. URL `https://www.lifescied.org/doi/10.1187/cbe.13-06-0115`.

[39] Yong Cui, Jason D. Robinson, Seokhun Kim, George Kypriotakis, Charles E. Green, Sanjay S. Shete, and Paul M. Cinciripini. An open-source web app for creating and scoring qualtrics-based implicit association test, 2021.

A Appendix

We have made the teaching and supplemental materials public and available for download and adaptation. We hope this helps lower barriers to implementing the Gender-Design IAT into their course curriculum. These materials include the module slides and reading list, the IAT score visualization R script, and the Gender-Design IAT zine, and pre- and post-workshop surveys to gauge effectiveness of the module. For additional details and to access all materials used in this teaching module and study, please visit:
https://github.com/theLifeofY/ASEE2026-open-source-curriculum

4-digit PIN (write-in):_________ Date:_________

IDETC2025 Workshop Participant Questionnaire 1

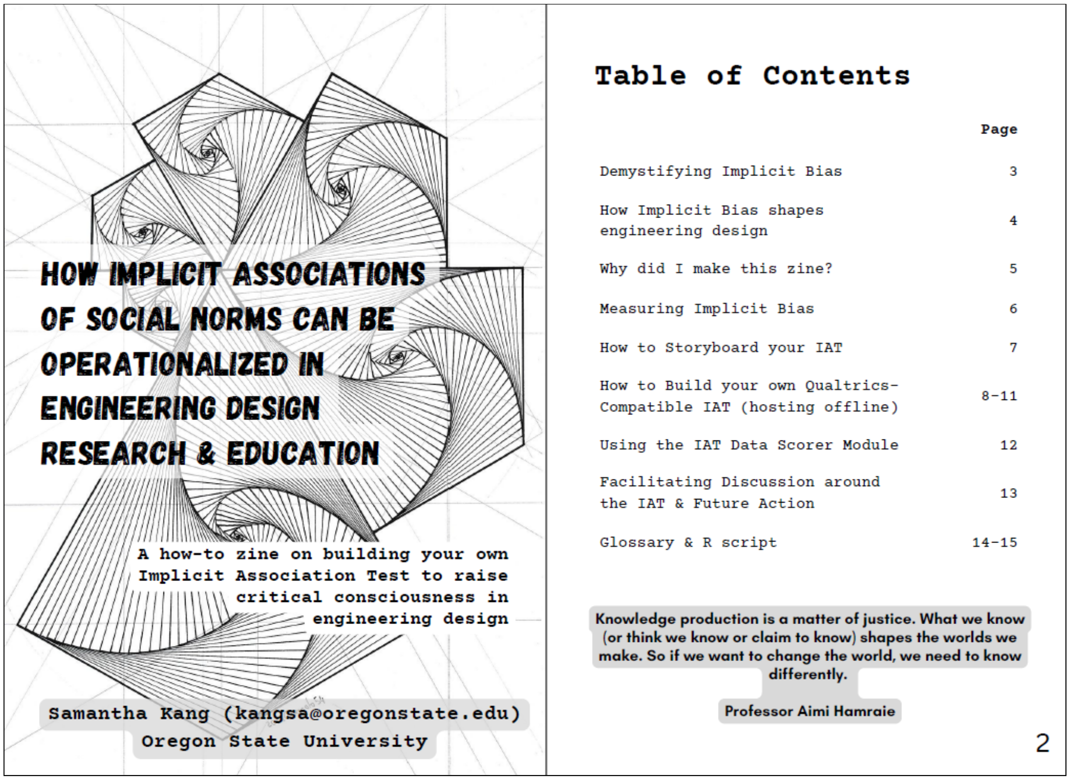
For items 1-6, identify your degree of agreement with each statement by circling one answer.	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
1. It is likely that I have certain biases when making technical engineering decisions of which I am unaware of.	SD	D	N	A	SA
2. I have a difficult time noticing how certain unrecognized assumptions or preferences can influence my design decisions.	SD	D	N	A	SA
3. I tend to make design decisions quickly without much reflection on how my own perspectives might be influencing my design work.	SD	D	N	A	SA
4. I am confident in my ability to identify and address situations where my potential biases might affect design decisions.	SD	D	N	A	SA
5. I have a lot of exposure to people with different social, cultural, economic, professional identities (i.e., disability status, SES, race/ethnicity, gender identity, sexual orientation, etc).	SD	D	N	A	SA

Please rate the extent to which (circle one):	Not at all				Completely
6. Individuals can become aware of their implicit biases.	1	2	3	4	5
7. Individuals can learn to manage their implicit biases.	1	2	3	4	5
8. Individuals can eliminate their implicit biases.	1	2	3	4	5

For items 11-17, indicate how well it describes you by circling the appropriate letter on the scale at the top of the page: A, B, C, D, or E. Read each item carefully before responding. Answer as honestly as you can. Thank you	Does **not** describe me well				Describes me very well
9. I sometimes find it difficult to see things from the other person's point of view	A	B	C	D	E
10. I try to look at everybody's side of a disagreement before I make a decision.	A	B	C	D	E
11. I sometimes try to understand my friends better by imagining how things look from their perspective	A	B	C	D	E
12. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments	A	B	C	D	E
13. I believe there are two sides to every question and try to look at them both	A	B	C	D	E
14. When I'm upset at someone, I usually try to "put myself in their shoes" for a while	A	B	C	D	E
15. Before criticizing somebody, I try to imagine how I would feel if I were in their place	A	B	C	D	E

Please give your completed survey to a facilitator. Thank you.

Figure 8: Pre-workshop survey questions. For full post/exit surveys, please visit: https://github.com/theLifeofY/ASEE2026-open-source-curriculum



HOW IMPLICIT ASSOCIATIONS OF SOCIAL NORMS CAN BE OPERATIONALIZED IN ENGINEERING DESIGN RESEARCH & EDUCATION

A how-to zine on building your own Implicit Association Test to raise critical consciousness in engineering design

Samantha Kang (kangsa@oregonstate.edu)
Oregon State University

Table of Contents

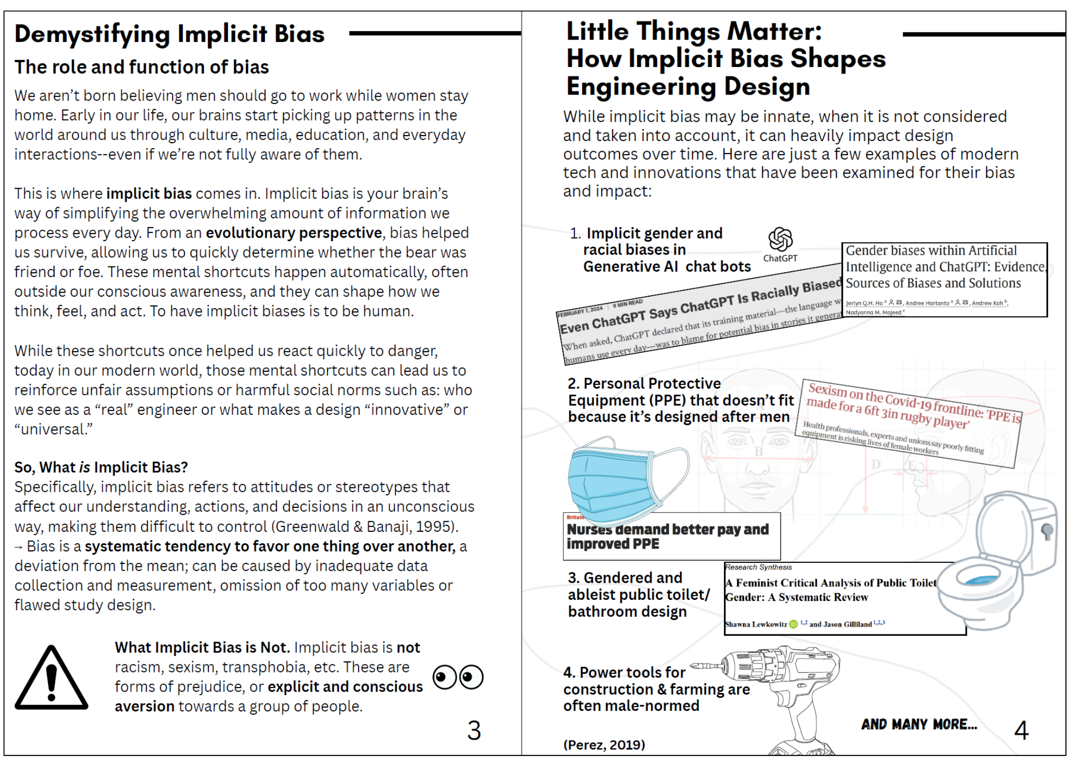
	Page
Demystifying Implicit Bias	3
How Implicit Bias shapes engineering design	4
Why did I make this zine?	5
Measuring Implicit Bias	6
How to Storyboard your IAT	7
How to Build your own Qualtrics-Compatible IAT (hosting offline)	8-11
Using the IAT Data Scorer Module	12
Facilitating Discussion around the IAT & Future Action	13
Glossary & R script	14-15

Knowledge production is a matter of justice. What we know (or think we know or claim to know) shapes the worlds we make. So if we want to change the world, we need to know differently.

Professor Aimi Hamraie

2

Figure 9: Zine designed for the teaching module and workshop, which could be used as an assigned reading for the module



Demystifying Implicit Bias

The role and function of bias

We aren't born believing men should go to work while women stay home. Early in our life, our brains start picking up patterns in the world around us through culture, media, education, and everyday interactions--even if we're not fully aware of them.

This is where **implicit bias** comes in. Implicit bias is your brain's way of simplifying the overwhelming amount of information we process every day. From an **evolutionary perspective**, bias helped us survive, allowing us to quickly determine whether the bear was friend or foe. These mental shortcuts happen automatically, often outside our conscious awareness, and they can shape how we think, feel, and act. To have implicit biases is to be human.

While these shortcuts once helped us react quickly to danger, today in our modern world, those mental shortcuts can lead us to reinforce unfair assumptions or harmful social norms such as: who we see as a "real" engineer or what makes a design "innovative" or "universal."

So, What *is* Implicit Bias?
Specifically, implicit bias refers to attitudes or stereotypes that affect our understanding, actions, and decisions in an unconscious way, making them difficult to control (Greenwald & Banaji, 1995).
→ Bias is a **systematic tendency to favor one thing over another,** a deviation from the mean; can be caused by inadequate data collection and measurement, omission of too many variables or flawed study design.

What Implicit Bias is Not. Implicit bias is **not** racism, sexism, transphobia, etc. These are forms of prejudice, or **explicit and conscious aversion** towards a group of people.

3

Little Things Matter: How Implicit Bias Shapes Engineering Design

While implicit bias may be innate, when it is not considered and taken into account, it can heavily impact design outcomes over time. Here are just a few examples of modern tech and innovations that have been examined for their bias and impact:

1. **Implicit gender and racial biases in Generative AI chat bots**

ChatGPT

Gender biases within Artificial Intelligence and ChatGPT: Evidence, Sources of Biases and Solutions

Even ChatGPT Says ChatGPT Is Racially Biased

2. **Personal Protective Equipment (PPE) that doesn't fit because it's designed after men**

Sexism on the Covid-19 frontline: 'PPE is made for a 6ft 3in rugby player'

Nurses demand better pay and improved PPE

3. **Gendered and ableist public toilet/ bathroom design**

A Feminist Critical Analysis of Public Toilet Gender: A Systematic Review

4. **Power tools for construction & farming are often male-normed**

AND MANY MORE...

(Perez, 2019)

4

Figure 10: Zine can also be used as an introduction to implicit bias