

DETC2016-60382

**COGNITIVE EMPATHY IN DESIGN COURSE FOR A MORE INCLUSIVE
MECHANICAL ENGINEERING**

Kathleen Wong (Lau)
Southwest Center for Human
Relations Studies
University of Oklahoma
Norman, OK, USA

Rebecca L. Norris
School of AME
University of Oklahoma
Norman, OK, USA

Zahed Siddique
School of AME
University of Oklahoma
Norman, OK, USA

M. Cengiz Altan
School of AME
University of Oklahoma
Norman, OK, USA

James Baldwin
School of AME
University of Oklahoma
Norman, OK, USA

Wilson Merchan-Merchan
School of AME
University of Oklahoma
Norman, OK, USA

ABSTRACT

Cognitive Empathy, often referred to as perspective taking, refers to the ability to identify and understand details about another's experience so that one can understand why people may think and feel the way that they do. In recent years the need for designers to develop Cognitive Empathy skills has been recognized and has given rise to human-centered design and empathic design. Many mechanical engineering and design departments offer courses and have programs in these emerging topics. Mechanical engineers need to have basic understanding of Cognitive Empathy to function in today's workplace. In addition, most mechanical engineering undergraduate programs do not have a diverse student body representative of the general population. Although there are many reasons, we believe that having a welcoming, inclusive environment is a precursor to improving diversity and thus should be an important consideration in mechanical engineering education. We propose that introducing carefully designed training on Cognitive Empathy in design courses could result in (i) a more welcoming and inclusive environment and (ii) a new generation of designers better equipped to consider the users. In this paper we present an "Intercultural Cognitive Empathy" training that was given to all mechanical engineering seniors at the University of Oklahoma to create a more inclusive environment. The students in a senior design course received the training at the beginning of the semester, before forming their design teams, so that they could use the skills to better communicate with each other. Cognitive Empathy research provided the foundation for the training and intercultural active learning components were also

integrated. A student survey, done at the end of the semester, showed that students retained and used different components of the training throughout the semester. The assessment strongly suggests that this training should be part of the regular curriculum.

**1 COGNITIVE EMPATHY TRAINING AT THE
UNIVERSITY OF OKLAHOMA**

The School of Aerospace and Mechanical Engineering (AME) at the University of Oklahoma has, over the last year, been building on existing School- and College-level programs to increase inclusion and diversity within our department, which fits with our stated mission of providing "the best possible educational experience for our students through excellence in teaching, research and creative activity, and service to the state and society, nationally and internationally" [1]. We have found that many mechanical engineering programs, ours included, have student enrollments that are not particularly diverse (for example, our female student population makes up only about 11% of our mechanical engineering majors), and creating a more inclusive environment within our school will play a key role in allowing us to increase the diversity of our student body over time.

We have also recognized industry trends emphasizing the importance for mechanical engineers to be skilled in human-centered and empathic design, skills which cannot be fully developed until a student first develops some ability in cognitive empathy. Brown [2] highlights empathy as one of the characteristics of design thinkers: "Empathy. They can imagine

the world from multiple perspectives—those of colleagues, clients, end users, and customers (current and prospective). By taking a “people first” approach, design thinkers can imagine solutions that are inherently desirable and meet explicit or latent needs. Great design thinkers observe the world in minute detail. They notice things that others do not and use their insights to inspire innovation” (Page 3, [2]). Kouprie and Visser [3] describe “empathic” as a “quality of designing” and propose a framework for empathy in design. Others have also highlighted empathy for creative design [4-6]. Furthermore, due to ever-changing population demographics in the United States and the growing recognition of the value of diverse teams, we believe that some training in teamwork, communication, and empathy is an essential component of engineering education, particularly given the prevalence of teamwork-centered engineering work environments (Page, 2007; [7]).

One program we have initiated to help us create a more inclusive environment in our department is a diversity and inclusion training program for students, faculty, and staff. The first round of this training was given to all mechanical engineering seniors in Fall 2015, and we have plans to extend the training to all AME seniors and sophomores in phases over the next several semesters. In order to create the most effective and professional training for our students, we decided to work with an expert in the field, Dr. Kathleen Wong(Lau) of the Southwest Center for Human Relations Studies. After meeting together with us several times, Dr. Wong(Lau) created a training program custom-made for engineering students focusing on research-based cognitive and behavioral frameworks for practicing inclusive intergroup communication that facilitates intellectual diversity and innovation in work teams.

The student training was carried out in AME 4163 (Principles of Design), also called the pre-capstone course, which is a senior level mechanical engineering design course at the University of Oklahoma. In this course through appropriate scaffolding, students are provided with an opportunity to explore and experience issues and tools related to design through a group design project. The problem given is vague on purpose as to reflect a real world issue and emulate authentic design problems. The design problem does not have a fixed solution and provides students the opportunity to explore an open design space. To provide context students are input into the fictitious world of “Planet Vayu”, where they are solving a problem that is plaguing the planet. They are provided with a background of the problem and how it is affecting the planet. They are asked to understand the needs of the community, designer, manufacturer, and any other possible stakeholders. The scaffolding provided through the class includes an outline of the design process the students follow during each lecture to show where the new information takes place. The students form self-organized teams and are then guided through a “conceive-design-build-test-and-reflect” experience, with an emphasis on the development of digital prototypes and use of the prototypes for analysis. The design problem is open and the design process

used is similar to that used in industry, which allows appropriate experiences to develop related competencies.

2 EMPATHY AND INTERGROUP DIALOGUE APPROACHES - BACKGROUND

Intergroup (within a group) dialogue as it is most widely practiced in higher education is a form of educational practice that utilizes multidisciplinary conceptual frameworks from intergroup relations theory and social justice education. This form of practice, based in a structured curriculum and facilitative pedagogy, engages undergraduate students in face-to-face sustained dialogic communication about issues of diversity, social justice, and identity at the personal and intergroup levels [8-13]. Intergroup dialogues are designed to reduce prejudice through structured interaction between members of dominant identity groups and members of subordinate identity groups, often engaging with each other across racial/ethnic identities, gender identities, and religious identities.

Cognitive Empathy is a key component within intergroup dialogue because interaction can involve empathic relations between individuals whose life experiences, attitudes, and group identities are remarkably divergent across many social dimensions including race, ethnicity, class, gender, migration, and religion, as well as other dimensions not commonly recognized as traditional social identities including rural/urban, regional, family status, parental status, political, military identity, etc. What is the process of empathy, particularly intercultural empathy among such culturally divergent individuals and groups?

Intercultural communication scholars have long held that empathy is a necessary component of intercultural competency and essential for bridging cultural differences [14-17]. Broome [18] developed a theoretical model of relational empathy in intercultural communication which frames the process of empathy as a co-creational process in which interactants create a third culture of interdependent meaning, world view, interpretations and reality. The concept of relational empathy recognizes that persons cannot possess first-hand knowledge of the emotional states nor cognitive processes of others. The relational empathy model assumes that individuals can never totally cognitively understand the experiences of others nor experience the feelings of others with complete accuracy. Individuals instead jointly create interdependent understanding of experiences and empathy that are reflective of and shaping of their intercultural relationship dynamic.

Intercultural communication scholars Martin, Flores, and Nakayama [17] lay out principals of ethical models of communication, including the dialogic principle which utilizes Buber’s [19] I-Thou to frame empathic communication as a result of dialogue among people who are willing to open themselves up to new relational meaning in the ways in which Broome [18] has laid out in his model of relational empathy. Martin, Flores, and Nakayama [17] also caution about the cultural constraints that influence dialogic communication of empathy, noting that our U. S. individual-centered

communication model is culture bound—“empathy works best among people who share similar cultural backgrounds” (p. 365). For individuals who have different cultural backgrounds from one another, cognitive empathy encompasses learning about others’ experiences in an “intellectual way” (p. 366) as opposed to learning about and developing subsequent feelings for others across cultural groups, which can be more difficult.

Empathy has been defined from an everyday lay perspective as being able to put oneself “in the shoes of another” person. In the social sciences the definition of empathy has been heavily influenced by the disciplines of counseling, psychology, and psychotherapy [20-21]. Empathy is defined as the ability to perceive another individual’s frame of reference on emotional components and meanings with accuracy as if one were the person one is empathizing with. Cognitive therapists define empathy as necessary for relationship development. The ability to empathize is also seen as important to bridging differences across multiple perspectives and life experiences. Empathizing emotionally with outgroup members (a social group towards which an individual feels contempt, opposition, or a desire to compete, as opposed to an ingroup, which is a social group towards which an individual feels loyalty and respect) can lead to a concern for outgroup members’ welfare and more positive feelings and attitudes towards outgroup members [22-24]. Increasing cognitive empathy or perspective taking can also lead to more positive attitudes towards outgroup members [23].

In intergroup dialogue research, empathy is viewed as an essential process that facilitates the reduction of prejudice in intergroup contact. The primary explanation is that empathy reduces perceptions of dissimilarity and feelings of threat by helping individuals understand that they share a common fate and have similar human experiences with others who may seem to be very different than themselves [25]. Finlay and Stephan [26] state that intergroup empathy can lead to arousing feelings of injustice for others. Through the process of empathizing with outgroup members, individuals can experience cognitive dissonance from their new empathic understanding and feelings contradicting their previously held negative prejudices and negative feelings. This cognitive dissonance can mediate changes in attitude towards the outgroup and reduction of outgroup prejudice. In general cognitive empathy refers to taking the perspectives of others or understanding the experiences and opinions of others [27-28]. Cognitive empathy is often referred to in the literature as perspective-taking or role taking. Emotional empathy refers either to the similar emotional responses to another person (parallel empathy) or the emotional reaction to another person (reactive empathy). In interpersonal communication studies, empathy has been conceptualized as a multi-dimensional construct comprised of cognitive aspects, emotional aspects, and communicative aspects. Cognitive empathy has aspects of perspective-taking, reflecting the ability of the individual to adopt the viewpoint of another [29].

Most recently in *Beyond Reason and Tolerance: The Purpose and Practice of Undergraduate Education*, Thompson

[30] focuses on the role of empathy in leadership in the 21st century in the ever complex adaptive systems of team problem solving required in modern organizations. Empathy is viewed as a driving mechanism for the work of interdependent agents and teams requiring high levels of emotional intelligence. Cognitive empathy is increasingly seen as an important component of STEM education, and the move to include holistic engineering education as an important thread of preparing students to engage with complex problem solving in their work as engineers [31-32]:

We argue that empathy, which we understand to entail both the intuitive emotional as well as the cognitive aspect of “perspective taking”, enables engineering students to develop a nuanced, critical understanding of the multiple perspectives which characterize contemporary engineering problems.

3 INSTRUCTIONAL DESIGN OF COGNITIVE EMPATHY TRAINING

With the goal of improving our students’ communication and empathy skills, Dr. Kathleen Wong(Lau) of the Southwest Center for Human Relations Studies designed a diversity and inclusion training workshop specially targeted to AME’s students, faculty, and staff. The objective of this training is to provide students with research-based cognitive and behavioral frameworks for practicing inclusive intergroup communication that facilitates intellectual diversity and innovation in work teams. The 2.5 hours of training is facilitated over two classroom meeting times. Dr. Wong(Lau) facilitated our first round of training during the first week of September 2015. The training took place over two days in AME 4163, our pre-Capstone course in which students work in small teams to master design process and methodology skills, from concept through analysis, that they will use in their Capstone Senior Design course the following semester. All ME seniors attended as well as some students on our design competition teams and several faculty and staff members. The training was generally well-received (see Training Outcomes below).

This research-based training curriculum provides experiential modules on: intercultural communication skills in teamwork, inclusive dialoguing skills that lead to cognitive complexity and innovative thinking, and inclusive conflict skills that promote productive collective problem definition and problem solving. Modules include interactive exercises, intercultural communication practice sessions, and coached case study sessions. Dr. Wong(Lau) worked with members of our school’s Board of Advisors to create true-to-life examples for the case studies.

The training is designed within a framework of three major curricular goals: 1) provide cognitive framing to understand interaction across groups; 2) provide opportunities to practice communication skills anchored in new cognitive framing; and 3) shape future social action in intergroup connection. Social action, in the case of social and behavioral science, means an individual takes account of the behavior of others and is thereby oriented to a reflexive course of action [33]. Cognitive

framing and structured facilitated interaction have been shown in intergroup dialogue research to significantly reduce prejudice and stereotyping and significantly increase cognitive empathy and productive conflict solving across groups on difficult topics such as race, ethnicity, and gender [12]. Based in social psychology and the reduction of prejudice, intergroup dialogue practice is a theory based practice and pedagogy. The curriculum tacks back and forth between cognitive framing and practice of communication skills. This training module is a carefully adapted and remodeled version of intergroup dialogue curriculum which integrates intercultural communication theory and practice as well to heighten the effect of training in a very short time period.

4 CURRICULUM CONTENT: STRUCTURE OF THEORY AND PRACTICE

The following theories and frameworks were presented over the two-day training session (each day of training was one hour and 15 minutes) for the department's pre-Capstone mechanical engineering majors. The flow of activities for the two sessions are shown in Figure 1.

<p>SESSION 1</p> <p>Business/Civic Case for Cultural Diversity & Aggregate Cognitive Complexity</p> <p>Cognitive Framing and Skill Building</p> <p>Social Identity and Comfort in Communicating About Identity Issues</p> <p>Social Identity Activity</p> <p>Intercultural Communication/Small Group Cultural Dynamics and Cognitive Empathy Skills</p> <p>Intercultural/intergroup small group skills</p> <p>SESSION 2</p> <p>Social Psychological Concepts on Categorization and Reduction of Cognitive Complexity</p> <p>Stereotype Threat and Aversive Racism, Aversive Sexism</p> <p>Cognitive Empathy or Perspective-Taking</p> <p>Case Study – Perspective Taking</p>

Figure 1- Flow of Topics and Activities

4.1 Business/Civic Case for Cultural Diversity & Aggregate Cognitive Complexity

The very diversity in which we invest dollars and careers does not necessarily lead to aggregate cognitive complexity, which is the sum of efforts required for each constituent. People from differing ethnic or cultural backgrounds may acquire the same training, skill sets, and experience as people from the prevailing culture. They may also be likely conform to the organizational cultural hierarchies of discussion, conflict, and problem solving so that the very diversity that they were hired for does not appear in their everyday work and contribution of ideas and perspectives. In these cases, they will likely think about things in the same way as the majority, and the deeper differences disappear. Research at University of Michigan

clearly demonstrates that diversity of life, world views, and perspectives, which mostly come from racial and ethnic diversity, leads to more consistently innovative and responsive, agile solutions [7, 34-36]. Additional research has shown that gender diversity (i.e. having at least two women) on teams produces different levels of organizational connectedness across working groups and more peripheral inclusion of related data and information than in all male groups [37].

Diversity is also about producing intellectual diversity in organizations. Companies want employees who can connect with other people who are different than they are to learn new perspectives, understand new markets, innovate, adjust, and/or get rid of unproductive practices. Non-profits and companies want people who can connect intellectually to define complex problems of markets, services, and social problems. Diversity and inclusion is no longer just about being nice or making people feel welcome. Research on community and organizational resilience in urban planning, international planning, non-profits, governmental services, and corporate sectors found organizations with a high index of capacity for diversity and inclusion were more resilient and able compete and innovate during economic and organizational crisis.

4.2 Cognitive Framing and Skill Building

Social Identity and Comfort in Communicating About Identity Issues

Social Identity Theory (SIT) is the anchoring concept for students. SIT posits that there are identity dynamics at the level of ingroups and outgroups, minorities and majorities, as well as along cultural dimensions across a broad range of identities including race/ethnicity/sovereignty (Native and Indigenous identities), gender, sexual orientation, socio-economic class, immigrant/international status, religion/spirituality, and others. Students participate in a hands-on SIT exercise in which they use manipulatives to assist the cognitive framing and turn-taking with the purpose of structured interaction versus free talk (which can become unanchored from cognitive framing).

Intercultural Communication/Small Group Cultural Dynamics and Cognitive Empathy Skills

Students participate in intercultural communication and listening skills. During the processing of the exercise, students' responses and experiences are highlighted by the facilitator to introduce and provide an analytical lens for comparative differences and similarities in communication and conflict among people from different nations, regions of US, urban/rural areas, familial cultures, and ethnic cultural groups. This exercise is the building block of cognitive empathy skills. Students are presented with the research on cognitive empathy as an inclusive skill to facilitate innovative problem solving, cognitive complexity, and inclusive climate.

4.3 Social Psychological Concepts on Categorization and Reduction of Cognitive Complexity

Stereotype Threat and Aversive Racism, Aversive Sexism

Stereotype threat is a condition where an individual is performing in a situation where a stereotyped expectation is for underperforming or failing. In these domains individuals and groups suffer a noticeable and measurable cognitive deficit in completing demanding physical and intellectual tasks. During these situations, working memory, the unconscious part of the brain that directs and retrieves practiced responses and information, takes a hit as it becomes preoccupied with trying not to fit stereotype. Stereotype threat is easily invoked through the subtle or direct negative stereotype. It is not possible to think our way out of stereotype threats. If one tries, one introduces another cognitive loading activity of trying to convince oneself of not believing in stereotype.

Almost opposite to the stereotype threat is aversive racism and aversive sexism, which entail fear and preoccupation with not being labeled a racist or sexist, usually experienced by Whites and sometimes other groups. This produces a cognitive load on the working memory. Aversive racism and aversive sexism make it almost impossible to talk about race and very difficult to talk about racism, to the point that it is often avoided altogether. This can also cause cognitive deficits in performance at a point when you need your full cognitive capacity.

Both of these dynamics are relevant to high stakes performance situations where an individual requires a high cognitive capacity such as that needed for standardized tests, elite sports, teamwork under duress or tight deadline, important presentations, interviews, etc.

4.4 Cognitive Empathy or Perspective-Taking (Social Psychology)

The intervention to reduce cognitive deficits is cognitive empathy or perspective taking. Cognitive empathy is understanding another person's experiences or concerns in enough detail to understand why that person thinks and feels the way that they do. It does not require agreement with the other's perspective, but it does require detailed comprehension. The regular collection of detailed perspectives reduces sloppy categorical thinking and reduces the ability of stereotype threat and aversive racism and sexism to negatively impact cognitive capacity in high stakes performance arenas. Empathy training has been integrated into health care provider training, with research showing that even rudimentary and awkward communication of empathy by health care providers leads to increases in critical thinking, patient compliance, critical inquiry, and other measures of connections and relationships that leads to well-being for both providers and patients.

In intergroup dialogue research, cognitive empathy and intergroup empathy are key process mechanisms in the reduction of stereotyping. Empathy also helps interactants have productive conflict versus suppression of conflict, which increases problem solving and helps create a safe climate for all groups, especially those with marginalized perspectives and

experiences. Cognitive empathy also increases the motivation to bridge differences across social identity groups. One of the key paths to cognitive empathy is becoming literate in the perspectives of others. Most people are great at perspective giving, but not very skilled nor experienced in perspective-taking.

5 TRAINING MODULES

The following modules encompass the detailed information, how it was presented, and the exercises used to support the theories presented over the two-day training session (each day being 75 minutes long) for the department's pre-Capstone mechanical engineering majors.

Session 1

Social Identity: Understanding social and cultural identities across race/ethnicity, gender, immigrant/international status, sexual orientation, and socio-economic class.

Social Identity Sharing

The social identity activity (Figure 2) was designed for participants to share information about their social, race, ethnicity, religion, and socio-economic status with peers. Participants were divided into groups of 6-7, with each participant provided a labeled hula-hoop as a prompt to share specific personal information with the group. Sharing of personal information as designated by this activity helps participants feel comfortable and safe to have conversations related to subjects that they are usually not comfortable to share. People want to belong to groups. We compare ourselves to other groups and learn to put groups in hierarchies- ingroups and outgroups. Members of outgroups may be subject to ultimate attribution errors (error that attributes externally negative ingroup and positive outgroup to external behavior, and negative outgroup and positive ingroup to internal behavior), and outgroup homogeneity errors (i.e., everyone in that group is the same). People tend to privilege in-group members over outgroup members in many situations. This exercise helps participants realize the ways in which fellow participants may not fit with common preconceptions about their apparent groups.

Intercultural/intergroup small group skills

Participants in the training go through an activity to understand the effects of cues and their absence during conversations. The activity (Figure 3) involves students facing each other and one student talking while the other stared at the speaker without any feedback. The activity promoted understanding that active listening should involve

- asking good questions for clarification
- purposefully helping a speaker have voice and agency
- promoting understanding
- an interactive exchange
- intercultural active listening

- cognitive empathy as an inclusive skill to facilitate innovative problem solving, cognitive complexity
- inclusive climate and intergroup conflict skills that optimize conflict rather than suppress or avoid conflict



Figure 2- Trainees Participate in Social Identity Sharing Exercise

To help participants have a better understanding of the influence of culture on communication, the iceberg model was used (Figure 4). This model illustrates that the visual and observable aspects of a person are just the tip of factors that form a person, along with other attributes like beliefs, values, attitudes, and experiences. Understanding the full perspective of others is needed to be a good communicator and designer.

Place is produced through the historical and continuing accumulated experiences and meaning-making of people and groups. Invisible cultural rules of a space that almost seem normal within that culture because everyone visibly follows them, or at least does not protest them, can be very visible to an outsider. An awareness that different persons will have different backgrounds and experiences that form their behavior is needed to be a good communicator.



Figure 3 - Trainees Participate in Active Listening Exercise

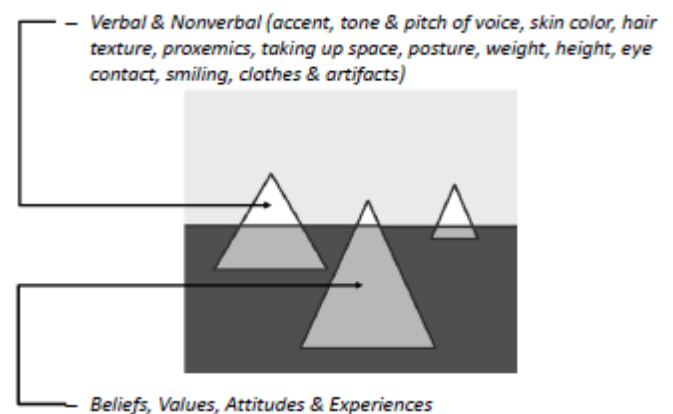


Figure 4: Iceberg Model of Culture and Communication

Session 2

Stereotype Threat and Aversive Racism/Sexism

Students receive a mini lecture on the research on Stereotype Threat and Aversive Racism/Sexism. Students are also reminded of the role of cognitive empathy in reducing the cognitive deficit effects of these social psychological mechanisms as well as how cognitive empathy increases

Table 1: Cognitive Empathy Training Survey Results on Improving Skills Related to Inclusion and Diversity

	When people make mistakes in communication on diverse teams, I now have some understanding of why these mistakes may occur.	When I make mistakes in communication on diverse teams, I now have some understanding of why these mistakes may occur.	I believe that the training component in the pre-capstone course raised my awareness about the importance of communication in teamwork on diverse teams.	I believe that the training component in the pre-capstone course taught me valuable skills that will help me in my future at OU and in the working world.	I believe that this type of communication and empathy training should be a regular part of the educational experience for Aerospace and Mechanical Engineering students.
Strongly Agree	47%	46%	39%	38%	42%
Mildly Agree	35%	36%	33%	31%	26%
Neutral	15%	15%	10%	19%	17%
Mildly Disagree	1%	0%	11%	7%	8%
Strongly Disagree	1%	3%	7%	6%	7%

cognitive complexity. Students are reminded that they can decrease stereotype threat by creating intergroup trust through intergroup empathy. Importance is placed on being able to talk about race and racism and sexism in matter-of-fact ways without discounting, avoiding, or overempathizing or overcompensating, and on being able to talk about gender, class, and sexual orientation in a similar fashion. Students are also taught the basics of setting up clear structural equity (for example, NCAA rules that address racist, homophobic behavior, etc. and coaches and staff who are trained to support these rules and policies). Structural action and individual action create inclusive organizations and the climate for intellectual diversity.

Case Study – Perspective Taking

The case study was developed based on experiences of several professional engineers, who are members of the Board of Advisors for AME. The case study involved people with different genders, cultures, ethnicities, and nationalities who have to deal with a problem on a professional engineering team. The students were given a description of the company and information related to different people in the scenario. The object of the case study was not to solve the problem, but rather to perspective-take and appreciate the development of critical dialogic empathy.

Different Levels of Empathy

Background information on empathy was presented, with examples, to help students gain a better perspective on empathy. Affective (the sensations and feelings we get in response to others' emotions) and cognitive empathy (how the other person feels and what they might be thinking), ideas from social psychology, were discussed, along with different levels of empathy, which include:

- *Relational empathy* for specific individuals
- *Intergroup group empathy* for specific groups
- *Critical dialogic empathy* for others that recognizes the structural positions of that individual and group in relation to power, privilege, and inequality in society.

Students need to develop critical dialogic empathy to be an active listener and also to be a better designer, who can consider and integrate the user more effectively.

Training Closure

The closure of the training reminded participants that we need to be aware that our subconscious and unconscious are not things we can willfully control as we can our conscious. However, research shows we can do things to shape our subconscious/unconscious processes. One technique is to be transparent and anchor who you are, and another is to give intergroup social support. Enacting cognitive empathy or perspective-taking is another important technique. Additionally, students should actively listen to other's perspectives, similar and different from their own, and give their perspectives in a way that allows room for other perspectives.

6 COGNITIVE EMPATHY TRAINING OUTCOMES

6.1 Inclusion and Diversity Outcomes

To assess the success of the training, we distributed a brief survey to all of the ME seniors in the pre-Capstone class during the last week of November and first week of December. Of 90 students enrolled in the course, 72 responded and the feedback was extremely positive (Table 1). The survey was performed at the end of the semester, approximately 3 months after the training. In regard to the statements "When people make mistakes in communication on diverse teams, I now have some understanding of why these mistakes may occur" and "When I make mistakes in communication on diverse teams, I now have some understanding of why these mistakes may occur," 82% of respondents mildly or strongly agreed. Another 72% believe that the training raised their awareness about the importance of communication in teamwork on diverse teams and 68% think that the training taught them valuable skills to use both at OU and in their future careers. 68% agree that this training should be a regular part of the curriculum for AME students. Between 10-19% of respondents were neutral on each statement and between 2-18% mildly or strongly disagreed with each statement.

6.2 Student Responses

The survey also contained two questions in which respondents could write in an answer. The first (Q6) asked students to describe the most significant thing they learned from the training, to which there were some truly insightful responses about the value of diverse teams and the importance of good communication and empathy within teams. Even though there had been two months between the training and the survey, several students referenced specific terms or ideas covered in the training. Some students commented on the value of working in a diverse group: "I learned that although working with a diverse group of student may be difficult at times, it proved to be an extremely valuable experience by providing learning opportunities from many different points of views." The second open-field question (Q7) asked students to describe something that they learned from the training that they have used already. Overall, outside of a couple of "common sense" comments, the feedback was very positive. Again, communication skills were widely referenced and many students indicated that they had already changed the way they are communicating in their teams. Some of the comments specific to different modules of the training are shared below:

The **Social Identity Sharing** activity helped students understand influence of a range of factors on how culture, environment, and background contributes to personality: "I learned how diverse even the small group of people I usually work with are." Another student commented, "I learned through the hoop exercise that there are many different parts of our lives that influence how we communicate, how we learn and what we think is important in our lives." The activity also helped students feel safe and empower them with the necessary tools to address and discuss uncomfortable topics. One student wrote "If there is an awkward subject or a tension between me and a teammate, I now know that talking through the issue in a professional manner will result in better understanding of the alternative point of view and prevent any further conflict."

The **in-groups and out-groups** discussion helped heighten student awareness regarding how a teammate might feel like an outsider and the importance of trying to see things from other points of view. One such comment: "I really gained a lot from the ideas of "in-groups" and "out-groups". This idea, along with many others mentioned in the lectures, validated my own theories about the nature of communication I have developed from my experience." It was validating to see from students comments the development of cognitive empathy by combining multiple topics from the training. A student shared, "It's easy for someone to feel like an outsider, try to view things from their perspective to try to gain context of how better to avoid or alleviate this and try to reflect if anything I do/have done will/has add/ed to this alienation."

Students also understood the **Aversive Racism/Sexism** concept and mentioned it as useful for communication: "The most significant was Aversive racism. I am not a racist, but have not experienced team work with people outside my own culture. Sometimes I would be afraid to ask a question due to possibly coming off as "stereotypical". I learned that if I am

sincerely interested in something from someone else's culture to simply ask a question like I would anyone else but to phrase it in a way that is not over-empathizing or over-compensating."

The **Intercultural/intergroup small group skills** were mentioned by a significant number of students in relation to the improvement of their communication skills. In response to a question about the most significant thing learned in the training one student wrote, "The portion on how important the right body language is and that it can set the mood for the entire conversation." Another student wrote, "I learned through the listening exercise that how we look, what we do and even how we nod our heads while communicating can change the course of the conversation. I have specifically started nodding my head in conversations both to ease tension in conversation and to specifically try to remember through head motions." The concept of personal space was intriguing to several students: "I learned that people seek a different amounts of personal space. So, I have been more understanding of people who come from different parts of the world who crowd my space because they are accustomed to less personal space."

Overall, there were many comments that highlighted how students used the concepts discussed in the training and understood the value of developing empathy and perspective taking. Several such comments are:

"Be aware of the diverse working environment I am and will be working in. It is important to be perceptive and empathetic in matters of diversity."

"The difference between the way we see ourselves and the way others see us."

"I have learned to be more empathetic to people."

Other students talked about the heightened awareness they gained through the training: "Consciously considering the perspectives of others has caused me to not completely change, but at least to reconsider my own personal views on the Syrian refugee situation." Although the survey did not focus on design, another student commented "I have learned to be more open when sharing ideas, this has helped me not to judge a concept too harshly in the beginning stages of design development."

7 DISCUSSION

It is clear from the training survey that students gained understanding of multiple concepts essential to the development of cognitive empathy and perspective taking. Design-thinking literature highlights the importance of empathy as a needed characteristic for designers. In our current study we did not study the effect of empathy on design; rather the focus was on whether students were developing cognitive empathy in general as a skill.

Based on our feedback, it is clear that this training went extremely well and that it is likely in a large part due to the way the material was presented to the students. Dr. Wong(Lau) was very strategic in how she covered the topics. She first focused on helping the students understand why diversity, inclusion, and communication skills that encompass diversity and inclusion are important to our students. The first several

minutes of her presentation focused on the business case for diversity; she pointed out research showing that employers are interested in having diverse workforce and that they actively seek inclusive employees. She also explained that Americans are becoming more diverse and that our students are more likely than any preceding generation to eventually work with people from different backgrounds. Only after laying the groundwork of why diversity and inclusion should matter to our students (beyond the moralistic reasons) did Dr. Wong(Lau) start addressing diversity and inclusion terms and ideas and helping our students learn to better communicate and empathize with diverse groups.

The training sessions were also quite collaborative, which added to their success. Dr. Wong(Lau) had prepared lecture slides, but she did not simply read from them the whole time. During lecture portions of the training, Dr. Wong(Lau) mixed in real-life examples, many based on her own experiences. She also had students complete interactive exercises with each other, which, based on some of the comments received, seem to have been eye-opening for many of them.

One factor that may have positively impacted the training was the presence of numerous faculty members. Approximately one-third of the AME faculty not only attended, but actively participated in the training session. Although we did not receive specific comments from the students on the presence of the faculty, we believe that their attendance and participation sent a strong signal to the students that the information was to be taken seriously and that this is a sincere effort to improve communication and inclusion on the part of the department.

Finally, asking leading members of our Board of Advisors to supply information for the case study Dr. Wong(Lau) used likely had a significant impact on how seriously our students took this training. First, it shows that diversity and inclusion-related incidents really are happening in their chosen profession and hopefully drove home the importance of having excellent communication and empathy skills. However, because these board members are all executives at prominent engineering firms that employ many of our graduates, it also signaled to our students that the information covered in our training sessions really is of importance to their future employers.

In the future we plan to expand our training to students taking sophomore level design courses, with the senior level training used as a refresher. The content for the sophomore level course will be modified to cover how to use cognitive empathy to be successful in an engineering curriculum and how it relates to design thinking. At the senior level we will broaden our data gathering and assessment to evaluate the influence of cognitive empathy on student design. This will require us to provide students will a project that will have the potential to take perspective taking of users.

ACKNOWLEDGEMENT

We also want to thank Gallogly College of Engineering for providing support and funding for many of the School of AME activities for a more inclusive environment. We are grateful to be part of the TECAID, Transforming Engineering Culture to

Advance Inclusion and Diversity, program. TECAID is a joint project of the Women in Engineering ProActive Network (WEPAN) (Diane Matt, PI), the American Society of Mechanical Engineers (ASME) (Thomas Perry and Aisha Lawrey, co-PIs) and Purdue University (Klod Kokini, co-PI). TECAID provides expert and community support to propel the work of ME departments that are committed to research-informed, faculty-driven change to advance diversity and inclusion understanding and practices in the department and the ME program. TECAID's workshop-based intensive professional development, facilitated virtual learning community, and ongoing expert consultation provided by The Kardia Group (Diana Kardia, founder and lead consultant) provides robust support and guidance for participating ME department leaders and faculty. TECAID is supported by a grant (EEC #1445076) from the National Science Foundation program on Broadening Participation in Engineering.

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