2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #37992

Supporting Empathy Engagement throughout the Design Thinking Process

Dr. Katherine Brichacek, Northwestern University

Dr. Katherine Brichacek is a Postdoctoral Fellow at Northwestern University, where she teaches in the Weinberg College of Arts and Sciences and McCormick School of Engineering. Her current research is at the intersection of engineering education, ethics, and social philosophy.

Dr. Ordel Brown, Northwestern University

Dr. Ordel Brown is an instructional professor at Northwestern University in the McCormick School of Engineering and Applied Science, where she currently teaches first-year engineering design courses. Her research interests in engineering education include first-year engineering experience enhancement strategies, retention of underrepresented groups in engineering, and inclusion and equity in engineering design.

Laura Maria Pigozzi PhD, Northwestern University

Dr. Laura Maria Pigozzi holds a PhD in Rhetoric and Scientific & Technical Communication with a doctoral minor in Bioethics. She has taught professional communication since 2010, first at the University of Minnesota and, since fall 2018, at Northwestern University. Prior to her academic career, she has worked as a R&D engineer, a technical writer, and a business owner.

Dr. Pigozzi's research stands at the intersection of the rhetoric of health and medicine, technical and professional communication, intercultural communication, and immigrant health.

Supporting Empathy Engagement Throughout the Design Thinking Process

Introduction and Background

Wicked problems [1] are poorly defined, affect multiple, sometimes competing stakeholders, and are almost impossible to solve. Engineers are in a position to mitigate harms caused by these problems. Yet, engineering design curriculum does not often provide undergraduate students the opportunity to engage with wicked problems. Instead, students often engage in well-defined and structured exercises that do not reflect the complexity of real-world, wicked problems [2]. When students do engage with wicked problems, either in the classroom or later as professional engineers, they find them daunting and difficult. Tackling such problems requires unconventional approaches such as an awareness of positionality and sustained empathy in the engineering design process. While this process incorporates the concept of empathy, it is not always explicitly, consistently, and intentionally emphasized.

Following recent calls to emphasize empathy in engineering design education [3], [4], [5], we draw on feminist accounts of virtue and care ethics, and scholarship in the philosophy of empathy to inform our approach to teaching empathy-based engineering design in an undergraduate, first-year engineering design course called Design Thinking and Communication (DTC). DTC is a human-centered design course required for all engineering undergraduates enrolled at Northwestern University in Evanston, Illinois. The course requires students to interact with clients and users through activities that include interviews, observation, and testing. The wicked problems the students confront can include food insecurity, education, poverty, or challenges for people with cognitive and physical disabilities.

Our course uses the Stanford design thinking model (see Fig. 1), which begins with empathy. While this model does explain that empathy affects the defining stage of design thinking, it does not provide direction for sustained empathizing throughout the other three stages.

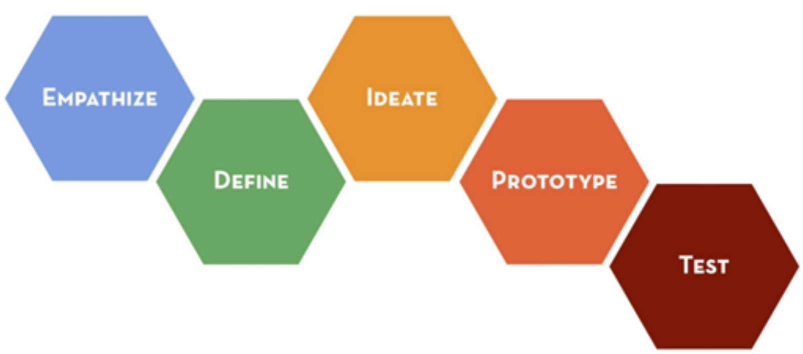

Fig. 1: The Stanford Model for Design Thinking [6]

In this work-in-progress paper at the exploratory phase, we investigate how our curriculum influenced by virtue ethics, care ethics and the philosophy of empathy affects student engagement with empathy in the design thinking process. By drawing on philosophy scholarship, as opposed to neuroscience and psychology, our explicit empathy instruction is rooted in teaching empathy as an ethical obligation that transcends one step in the design thinking process. In other words, our approach to teaching design thinking infuses empathy at all stages of the process. Through this approach, we aim to demonstrate that empathy as an ethical obligation is a long-term commitment to empathic engineering that is influenced by one's identity and biases.

Feminist virtue ethics

Virtue ethics is rooted in Aristotle's *Nicomachean Ethics* [7]. As opposed to ethical theories that are concerned with deciding right action, such as utilitarianism and deontology, virtue ethics is concerned with developing virtuous character throughout the course of one's life. According to Aristotle, moral actions naturally follow from moral or virtuous character. This ethical system focuses on developing virtues such as wisdom, justice, courage, and temperance. To develop these virtues, one must habitually practice virtuous actions and critically reflect on the experience. Virtue ethics has largely been ignored until its resurgence in the middle of the twentieth century [8]. And, in recent decades, Aristotle's virtues were persuasively deemed androcentric [9]. Feminist ethicists have suggested adjustments to the original ethical virtues that better account for emotions in addition to reason. In this vein, we promote empathy as a virtue in the sense that we encourage the habitual practice of empathy throughout all stages of the design thinking process, not merely as an initial step. That is, by considering empathy under the framework of virtue ethics, we ask students to conceptualize empathy as a skill [10], [5] that requires habitual practice to hone. Building on the Stanford design thinking model which promotes empathy as the initial, single step of the design thinking process, our model incorporates empathy at every step in the process.

Care ethics

Care ethics as an ethical consideration was theorized by white women and did not include intersectionality. In recent years, scholars have proposed amendments to make care ethics more inclusive by moving away from care exemplified by relationships between primary caregivers and dependents and toward care that accounts for human flourishing in the face of multiple oppressive forces such as racism, ableism, classism, and sexism [11]. By drawing on care ethics and feminist virtue ethics, we aim to challenge positivist approaches to engineering design education which deny the effective role of emotions, care in general, and empathy in particular [12]. Our study encourages students to feel and name emotions and emotional nonverbal cues in others in order to develop attitudes and behavior consistent with empathy. Consistent empathy development can help students to critically engage with positivistic approaches to engineering design problems [12].

Philosophy of empathy

The fields of psychology and neuroscience have predominantly informed scholarship on empathy in engineering education. Most notably, Walter *et al*. [13], [5], have approached empathy instruction in engineering from a neuroscience perspective. By referencing neuroscience claims about the functional capabilities of the brain, specifically the brain's inability to simultaneously process emotions and rational thoughts, they promote empathy education that, at different times, encourages emotional or rational engagement with empathy. While psychology- and neuroscience-informed studies of empathy in engineering education are valuable, we shift the focus toward an ethical commitment to empathy in engineering design education. In the field of philosophy, there is robust debate on the value of empathy in addition to proper engagement with empathy. Philosophy of empathy is inherently concerned with the connection between empathy and ethics.

Among the earliest studies of empathy [14], [15], philosopher Hume described empathy as a human capacity that naturally happens in most people–we are able to feel what others feel. Because humans have the capacity to feel the emotions of others, humans could also decide how to act ethically toward one another based on the information gathered through empathizing [14]. This intentional commitment to empathy as a precondition for ethics [14], [16] informs our reference to empathy as an ethical obligation to the design thinking process.

In more recent scholarship [17], [18], empathy is described in two different ways: self-orienting and other-orienting. Self-orienting empathy asks individuals to hypothetically imagine that they are in the other person's position in order to understand that person's thoughts and feelings, while other-orienting empathy asks individuals to understand another's thoughts and feelings by not hypothetically imagining they are the other person—they instead stay themselves. Given that there is no clear consensus on which approach to empathy is better, we explored both approaches in our study.

Alternatively, philosophers such as Prinz [19] and Bloom [20], argue that empathy is a poor tool for ethical development. They claim that humans are poorly equipped to empathize with those different in character, race, gender, and ability than themselves. Instead, they turn to reason to encourage ethical decision making. We are committed to the connection between empathy and ethics in engineering education and recognize that students are not adequately trained to empathize. Therefore, as Walter *et al*. [13], [5] have argued, explicit empathy instruction is needed in engineering education. Our study explores effective means to maximize the development of empathic attitudes and behaviors, including positionality awareness.

Positionality awareness

Teaching positionality, or the recognition of one's identities, appears to encourage human-centered design. In their 2020 study, Walji *et al*. [21], found that explicit positionality instruction increased student self-awareness and deeper commitment to the communities they served in class. They used positionality "as a tool to elicit the values and biases that student engineers bring to their work, and as a strategy to better understand and interpret stakeholders [21]."

Considering Prinz and Bloom's critiques of empathy, by turning to positionality, we aim to encourage students to understand their identity and biases so they can recognize any potential barriers to empathizing with others, with an emphasis on empathizing with populations different than themselves.

Research Design and Analysis

Our research design consisted of writing prompts, incorporated into the course before students started the design thinking process, during the design research phase, during the prototyping phase, and at the end of the design thinking process. These assignments, along with writing assignments that are currently part of the course, were analyzed using grounded theory, an inductive qualitative research methodology.

The goal of our pilot study was to investigate students' perception of empathy in engineering design, and how positionality awareness impacts this understanding and subsequent empathic behavior and attitudes throughout the design thinking process. The research questions include:

> RQ1. How do students perceive the role and purpose of empathy in engineering design?
>
> RQ2. What do students define as empathic behaviors and attitudes?
>
> RQ3. How does positionality awareness impact students' demonstration of empathic behavior and attitudes?

The pilot study took place in one section of the required two-sequence, first-year, undergraduate, human-centered engineering design course (n=16). In the first sequence, the end users are primarily individuals with cognitive and/or physical disabilities. In the second sequence, the end users are more varied. All three authors teach this engineering design course at least once per year. This course is taken by students from all engineering majors, and focuses on the design thinking process. In our sections, the 5-step Stanford design model [6] is explicitly used. As noted, targeted writing prompts were incorporated before students started the design thinking process, during the design research phase, the prototyping phase, and at the end of the process. Beyond these prompts, there were no set assignment submission requirements suggesting where in the design thinking process students should engage with empathy. The sustained engagement with empathy intentionally reflects our commitment to feminist and care-based virtue ethics by asking the students to consider how they can develop their empathic skills throughout the design thinking process. We anticipated that the writing prompts and associated reflective discussions would inspire students to recognize the value of empathy in the design thinking process and demonstrate such value through self-oriented and other-oriented empathy activities such as client interviews and positionality evaluations. This approach is supported by virtue ethics in which reflection is necessary to develop the virtue (empathy) at stake [7].

To evaluate how empathy was actually employed by the students, we analyzed the targeted and typical assignments using grounded theory. This rigorous methodology employs the following processes: data collection (student assignments), coding, memo writing, and analyzing.

Qualitative research is appropriate to investigate the study's research questions as the qualitative analysis' focus on words pairs well with our unit of analysis—written assignments. Additionally, the "local groundedness [22]" of the data accurately reflects the student's understanding of the concepts under investigation. The conceptual framework, a common tool used in grounded theory, shown in Fig. 2 locates this pilot test within the larger goal of preparing engineering students to engage with wicked problems.

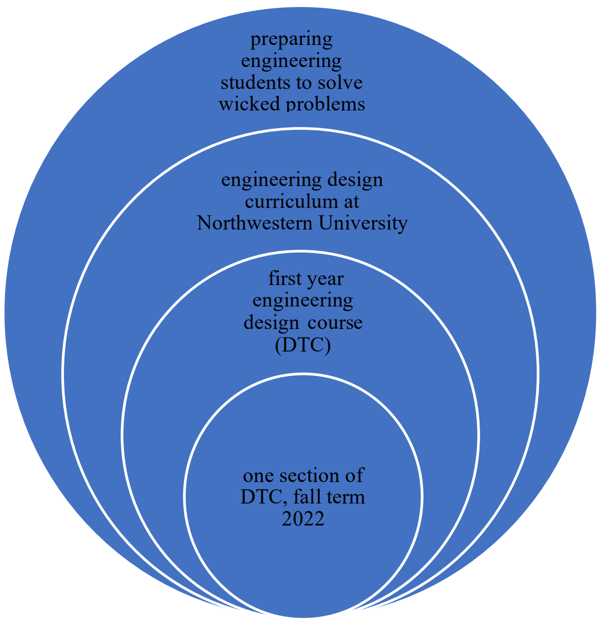

Fig. 2: Conceptual Framework

To answer RQ1, we analyzed students' responses to the following prompt (P1 below) that was administered as a pre-course test.

> P1. What, if any, is the role and purpose of empathy in engineering design?

To answer RQ2 and RQ3, we analyzed two sets of reflective prompts; the first was a prompt on positionality (P2 below) administered at mid-term, and the second was the original pre-course prompt (P1) administered as a post-course test.

> P2. Reflection on human dignity and empathy in engineering. This activity asked the students to analyze what social and personal identities they find most important and then use the following questions to compose a reflection.

- How might any one of your identities affect your ability to empathize with your client and users? What might you do to address any gaps?
- How might recognizing your identities impact your ability to conduct primary and secondary research and brainstorming?
- How does your expertise as a designer contend with lived experiences of the client and users?
- How do the client's and users' values, goals, intentions, objectives, or expectations conflict with your own? How will you address situations where your views conflict?
- Consider the experiences you wish to create for your client and users. How might an awareness of your identities influence these experiences?

As part of the final report required in this class, students were asked to include several prescribed appendices, two of which were an Interview Summary (describing an interview with the client and user to understand the engineering design problem) and an Observation Summary (describing an observation of the user performing an activity that involved the engineering design problem). The students were asked to read a document, authored by the researchers, about empathic interviewing prior to the interview and observation. These summaries were chosen to be part of the data set as these activities could be examined to see if the students included empathic elements in their descriptions of the interactions.

Results and Discussion

The pre- and post-test empathy assignments, the Positionality Assignment—Reflection on Human Dignity and Empathy in Engineering—and the two summary appendices were coded manually. The initial coding was a combination of descriptive, in vivo, and process coding. Secondary coding sorted the initial codes into provisional categories. According to Saldaña [23], "Focused [secondary] coding enables you to compare newly constructed codes during this cycle across other…data to assess comparability and transferability."

A memo, or analytic memo, "is a brief or extended narrative that documents the researcher's reflections and thinking processes about the data [22]." Memos capture ideas and thoughts throughout the research and analysis process. In this pilot study, memos were informally written on coding notes. The Second-Cycle codes and their definitions are shown in Table 1.

Table 1 Second Cycle Codes

Second Cycle Codes	Definition
actions	(descriptive) Actions that contribute to understanding or demonstrate empathy
descriptors	(descriptive) A word or phrase describing a process, a device, or individual interacting with a device
empathy	(descriptive) Recognition or use of empathy
mechanical	(descriptive) How a piece of equipment or process works. No emotions involved. Includes methodology.
positionality	(descriptive) Individual identities and their effects in and on the design thinking process.
solving problems	(process) Aspects of solving a design thinking problem
understanding	(process) Perceive a meaning
usable	(descriptive) How well a user can interact with a product/design in a specific context to achieve a specific goal [24]

The complete data corpus was then reviewed with the intent to refine the code definitions.

Pre-test

The pre-test data indicated that the students identify *solving problems* as an engineer's focus. The concept of *empathy* showed *understanding* anchoring most definitions. The site of *understanding* included the user's desires, needs, concerns, and to a much lesser degree, emotions. A design problem's solution should be *usable.* The concept of *usable* moves between inclusion of user considerations to mechanical usability (i.e., the design works). Aiding in *understanding* are identified *descriptors* such as context and humility. *Actions* identified as aiding *understanding* include flexibility, communication, compromise, and listening. *Positionality,* using the word "identity" was mentioned once. There were some *mechanical* passages, describing engineering work generally.

Post-test

The post test data was examined using the codes identified in the Pre-test. Results from the pre- and post-test show a shift in students' perception of empathy. The most notable shift was students' ability to articulate the value of empathy in informing and guiding the design thinking process and teamwork.

While the original codes held, some of the codes were developed in the following ways:

Table 2 Post-test Code Definitions

Second Cycle Codes	Definition additions
actions	(descriptive)
descriptors	(descriptive) values mentioned; context identified both physical and emotional
empathy	(descriptive) present throughout the design thinking process; informs and guides; part of teamwork; a way to understand
mechanical	(descriptive)
positionality	(descriptive) referenced by reference to unique identities, and varied backgrounds
solving problems	(process)
understanding	(process)
usable	(descriptive) more focus on user-friendly design and consideration of user's feelings, cross-over with understanding (user needs)

Interview summary

The data found in the Interview Summaries fell within four codes, *descriptors, mechanical, solving problems,* and *understanding.* The majority of the text was *mechanical,* objectively discussing how the students went about conducting the interview and what they learned, which involved *understanding* the design problem and consequently *solving problems.* The *descriptors* all related to the processes being demonstrated.

Observation summary

The data found in the Observation Summaries was similar to that in the Interview Summaries, falling into the same four codes. The number of descriptors was larger than those seen in the Interview Summaries. These descriptors all described the process or current device as problematic (e.g., frustrations, inconvenient, convoluted). Empathy was mentioned once by name, but the subsequent text did not describe an empathic event.

Students' Interview and Observation Summaries were devoid of reflections, application, or any mention of empathy. These results indicated that an understanding of such value does not necessarily translate to empathic action. This suggests that a mere understanding of the role empathy plays in the design thinking process is not a strong enough motivator for sustained empathy engagement and empathic action. This finding implies that continuous empathy instruction is needed for students to develop long-term commitment to consistent empathy practice.

Reflection on human dignity and empathy in engineering

These reflections varied in depth, with some addressing all prompts and others addressing just a few points. The data from this activity reflected what was seen in the pre- and post-tests regarding students' thoughts on empathy. As designed, the reflection also provided information on student's thoughts on positionality. Students acknowledged they may have difficulty fully emphasizing with others due to their individual identities. The focus of individual positionality fell into one of three areas: privilege, physical abilities, and life experiences. The data indicated that students felt that identity recognition can allow recognition of biases which affects understanding between the engineer and the client and users. One student importantly noted that ethnic and cultural differences can affect how empathy is approached. The authors speculate that because of their limited positionality, students struggled with making deeper connections with their client and users. Taken together, these results highlighted a baseline of students' perspectives on empathy and drawbacks to their empathic action, providing a guideline for future developments.

This pilot study's limitations center around the small convenience sample size (n=16). A small sample size precludes claims to significant relationships. However, the coding held its applicability across the data set, which is promising. The results are quite useful in adjusting our research design and approach as we plan our future research.

Future Work

The authors plan to conduct an IRB approved study in fall 2023 with four sections of the same engineering design course as used in the pilot study (n=64). The data set will be modified based on the results of the pilot study.

Because our results suggest that students do not consistently engage with empathy throughout the design thinking process, in future studies we propose a design thinking model that encourages more sustained empathy throughout the iterative process (see Fig. 3).

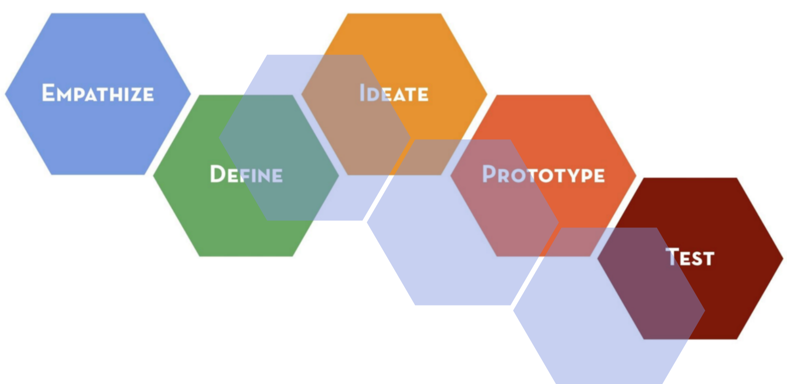

Fig. 3: Empathy-based Design Thinking adapted from the Stanford Model for Design Thinking [6]. The light blue hexagons depict empathizing beyond the first stage of the design thinking process.

Our proposed model (Fig. 3) for empathy-based design thinking aims to increase explicit empathy engagement at each stage of the design thinking process. The first stage, empathizing, will ask students to assess their positionality, understand the different kinds of empathy, and learn to detect and decode nonverbal cues. In the defining stage, students will be asked to actively listen and discern nonverbal cues when interviewing and observing their client and users, thus enabling the students to define the design problem from a position of empathy. In the ideating stage, students will be encouraged to engage in empathic brainstorming based on their prior empathizing and defining work. As in the first two stages of the design thinking process, the prototyping and testing stages will necessitate close engagement of the students with the client and users. Students will therefore be required to apply and hone the empathic skills they developed in the initial stages as they keenly listen to and observe users interacting with the proposed solutions, and factor empathy into core design decisions.

Further explicit instruction on virtue ethics is also intended to increase student awareness around the value of consistent empathic awareness and engagement as a long-term skill worth practicing.

In the pilot study results there were several single mentions of themes that warrant further inquiry. Those themes are:

- Empathy improved writing
- STEM background reinforces prioritizing efficiency
- Empathy (and communication) identified as *skills*, reflecting current literature trends [5], [10]

Additionally, there currently is no code being used to reflect wicked problems. The following mentions suggest aspects of wicked problems:

- Mention of global less privileged
- Mention of messy and convoluted design problems
- Mention of real-world problems

Conclusion

The aim of the present exploratory, work-in-progress study is to gauge the impact of our interventions on consistent engagement with empathy throughout the 5-steps of the design thinking process. Tenets from virtue and care ethics and philosophy of empathy informed our approach to encouraging consistent, long-term empathy. Preliminary results suggest that students do not consistently empathize throughout all 5-steps and require further interventions to encourage positionality awareness and sustained empathy.

Reference List

[1] E. Wilson and P. Mukhopadhyaya, "Role of empathy in engineering education and practice in North America," *Education Sciences,* vol. 12, no. 6, June 2022.

[2] B. -A. Schuelke-Leech, "The Place of Wicked Problems in Engineering Problem Solving: A Proposed Taxonomy," *2020 IEEE International Symposium on Technology and Society (ISTAS)*, Tempe, AZ, 2020.

[3] D. Bairaktarova, "Caring for the future: Empathy in engineering education to empower learning," *Journal for Engineering Education,* vol. 111, pp. 502-507, 2022.

[4] C. Calloway-Thomas, "A call for a pedagogy of empathy," *Communication Education,* vol. 67, no. 4, pp. 495-499, 2018.

[5] J. Walther, S.E. Miller and N.W. Sochacka, "A Model of Empathy in Engineering as a Core Skill, Practice Orientation, and Professional Way of Being," *Journal of Engineering Education,* vol. 106, no. 1, pp. 123-148, 2017.

[6] d.school Stanford University, "Design Thinking Bootleg," [Online]. Available: https://dschool.stanford.edu/resources/design-thinking-bootleg. [Accessed 25 February 2023].

[7] Aristotle, *Nicomachean Ethics*. Indianapolis, IN: Hackett, 1999.

[8] A. Baril and A. Hazlett, "The Revival of Virtue Ethics," in *The Camridge History of Philosophy, 1945-2015.* Cambridge: Cambridge University, 2019, pp. 223-236.

[9] R. Dillon, "Feminist Approaches to Virtue Ethics," in *The Oxford Handbook of Virtue Ethics.* Oxford: Oxford University Press, 2017, pp. 377-397.

[10] M. Fuller, E. Kamans, M. van Vuuren, M. Wolfensberger, and M. de Jong, "Conceptualizing Empathy Competence: A Professional Communication Perspective," *Journal of Business and Technical Communication,* vol. 35, no. 3, pp. 333-368, 2021.

[11] O. Hankivsky, "Rethinking Care Ethics: On the Promise and Potential of an Intersectional Analysis," *American Political Science Review,* vol. 108, no. 2, pp. 252-264, 2014.

[12] M. Erden, "Positivistic tendencies due to engineering education," *IFAC Proceedings Volumes,* vol. 36, no. 10, pp. 117-122, 2003.

[13] J. Walther, M.A. Brewer, N.W. Sochacka & S.E. Miller, "Empathy and engineering formation," *Journal of Engineering Education,* vol. 109, no. 1, pp. 11-33, 2019.

[14] D. Hume, *A Treatise on Human Nature*. Ottawa, Canada: East India Publishing Company, 2022.

[15] M. Slote, "The Mandate of Empathy," *Dao,* vol. 9, pp. 303-307, 2010.

[16] S. Fleischacker, *Being Me Being You.* Chicago: The University of Chicago Press, 2019.

[17] P. Goldiey, "Anti-Empathy," in *Empathy: Philosophical and Pscyhological Perspectives.* Oxford: Oxford University Press, 2011, pp. 302-317.

[18] A. Coplan, "Will the Real Empathy Please Stand Up?: A Case for a Narrow Conceptualization," *The Southern Journal of Philosophy,* vol. 49, pp. 40-65, 2011.

[19] J. Prinz, "Against Empathy," *The Southern Journal of Philosophy,* vol. 49, pp. 214-233, 2011.

[20] P. Bloom, *Against Empathy: The Case for Rational Compassion*. New York: HarperCollins, 2016.

[21] N. Walji, P. K. Sheridan, P. Kinnear, R. Irish, and J. Foster, "Who are you and how you work: Embedding positionality in engineering design," in *2020 Proceedings of Canadian Engineering Education Association (CEEA*), *Jun. 2020.*

[22] M. B. Miles, A.M. Huberman, and J. Saldaña, *Qualitative Data Analysis: A Methods Sourcebook*. 3rd ed., Thousand Oaks, CA: SAGE Publications Inc., 2013.

[23] J. Saldaña, *The Coding Manual for Qualitative Research*. Thousand Oaks, CA: SAGE Publications Inc., 2013.

[24] "Usability," Interaction Design Foundation, [Online]. Available: https://www.interaction-design.org/literature/topics/usability#:~:text=Usability%20is%20a%20measure%20of,deliverable%E2%80%94to%20ensure%20maximum%20usability. [Accessed 15 February 2023].