Fostering Empathy in Engineering Education

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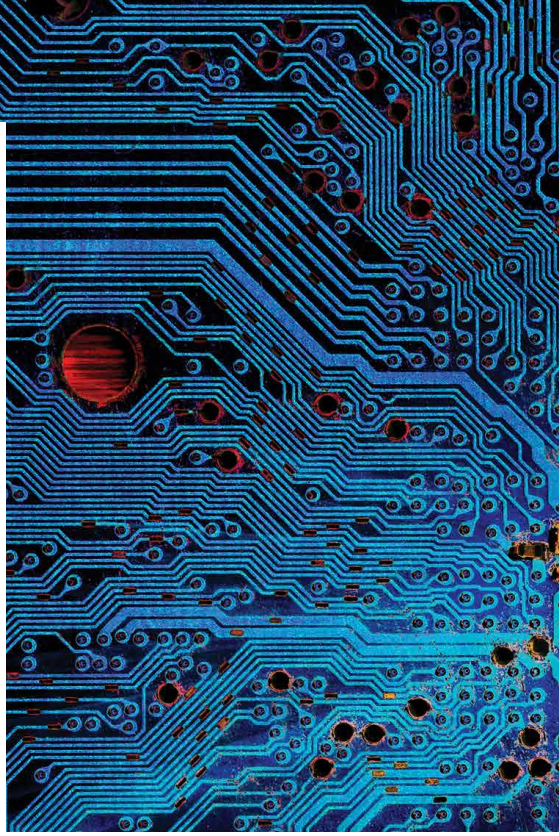
Scientia

FOSTERING EMPATHY IN ENGINEERING EDUCATION

Past research has found that engineering students graduate with less concern for the welfare of the public, and for the social implications of engineering design, than when they begin their studies. To address this issue, researchers from the University of Georgia have developed a theoretical model of empathy in engineering to provide a foundation for systematic research in this area, to inform pedagogical innovation, and to potentially impact the culture of the engineering profession in a way that incorporates a fundamentally different understanding of empathy.



The Importance of Empathy in Engineering

Loosely defined, empathy can be understood as the capacity to understand and share the feelings of others, and adequately respond to them. It is a form of social reasoning that enables one to imagine 'walking a mile in someone else's shoes', experiencing another's emotions, ideas, or opinions, without judgment. Empathy is often believed to be one of the key qualities for professional success in many, if not most, fields.

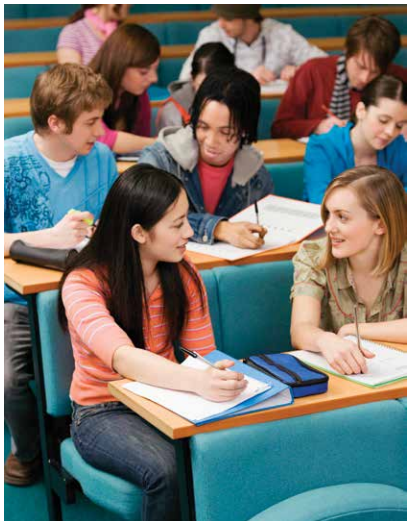
As the pace of technological and scientific advancement accelerates, it is becoming increasingly crucial for engineers to be empathic and attuned to the needs and experiences of a diverse range of stakeholders, including those who are directly and indirectly affected by their designs.

Engineers who excel in technical and social forms of reasoning are emerging as important industry leaders. Lisa P. Jackson, for example, past head of the US Environmental Protection Agency and current vice president of Environment, Policy, and Social Initiatives at Apple, attributes her career success to her early ability to both solve technical problems and effectively engage with members of the general public. Similarly, a study carried out by Google found that the best performing engineering teams were those that had high levels of 'social sensitivity' – a term that refers to the ability to pick up on and respond to the feelings and viewpoints of others. In the US, the Code of Ethics for Engineers specifies that professionals operating in the field should 'hold paramount the safety, health, and welfare of the public'. In other words, to adequately fulfil their duty, engineers are expected to be empathically aware of society's needs, carrying out their work with these in mind.

However, research has found that, over the course of their education, many engineering students tend to gradually cast aside their concern for the welfare of the public, and for understanding how people use and may be impacted by technology. This trend has been attributed to engineering education's relentless emphasis on solving technical problems, and the corresponding lack of focus on non-technical skills, such as ethical reasoning and empathic perspective taking.

Acknowledging the importance for engineers to develop both technical expertise and empathy-related skills and dispositions, many engineering programs have increased their focus on communication, teamwork, and interdisciplinary collaboration. However, course material specifically fostering empathy is still less common, possibly due to the lack of a coherent framework that defines and contextualises it in relation to the field of engineering.

So far, efforts to introduce empathy in engineering education have varied from immersive design experiences – connecting students with users they are designing technology for – to broader examinations of empathy in relation to engineering ethics, which ask students to consider the perspectives of those who are not present and incorporate these into their reasoning process.



The field of social work, in which empathy plays a key role, offers a range of theoretical frameworks and pedagogical approaches designed to foster empathy in students, preparing them for their professional practice. If appropriately adapted to fit engineering contexts, these frameworks could also be applied within engineering undergraduate programs.

By merging such social work frameworks and engineering concepts, a group of researchers at the University of Georgia has now developed a new theoretical model for empathy in engineering. The model defines empathy as a skill, orientation, and professional way of being. In addition to its other applications, the team has used their model to design a set of in-class activities to foster empathy in undergraduate engineering students.

The Empathy Project

In 2012, the University of Georgia established a new College of Engineering, aimed at educating students on how to be not only technically excellent, but also innovative and aware of humanistic aspects of working in complex socio-technical systems. This led to the development of new curricula for the College's eight undergraduate programs, which are designed to train engineering students on both technical and socially-relevant skills.

The Empathy Project is an interdisciplinary collaboration between engineering and social work educators, which addresses the increasing emphasis on how essential empathy is for effective engineering practice, and the related growing need to enhance empathy among engineers.

The primary researchers involved in the project include Dr Joachim Walther, associate professor of engineering education, Dr Shari Miller, associate professor and associate dean of the School of Social Work, and Dr Nicola Sochacka, research scientist in the CLUSTER research group at the University of Georgia. By sharing their diverse knowledge and expertise, these researchers aimed to develop a context-appropriate and conceptually cohesive way of applying empathy to engineering-related settings, and informing the culture of the profession.

A Model for Empathy in Engineering

The theoretical model, and related empathy modules delivered at the University of Georgia, are the product of a six-year collaboration between Drs Walther, Miller, and Sochacka. Complementing and expanding previous research efforts, the team's approach views empathy as central to both the design process and broader engineering practice. The team's model defines empathy as a skill, a practice orientation, and an overall professional way of being. These three dimensions are mutually dependent, supporting each other without a specific hierarchy or developmental trajectory. The researchers suggest that empathy, understood in this way, can be developed in students through educational approaches that draw on their innate empathic capacities.

The 'skill' dimension is adapted from Decety and Morigucci's (2007) model, which delineates four distinct socio-cognitive processes. The model adds a fifth process, and suggests that the combination of all five forms the foundation for an individual's capacity for empathic communication, relationship building, and decision making. These processes include affective sharing (the ability to share another's emotional state), awareness of self and others, seeing someone else's perspective, regulating emotions, and mode switching – the ability to switch between empathic and analytic skills in given situations.

The 'orientation' dimension includes a series of mentalities that affect how engineers approach practical situations, prompting them to empathically engage with others. For instance, openness predisposes engineers to be aware of and value the perspectives of others participating in, or affected by their work. Other orientations are related to productively working across the micro to macro spectrum when developing technology, considering others affected and the surrounding context, being reflective, and valuing diverse perspectives.

Finally, the 'being' dimension is related to the application of empathy skills and practice orientations in a broader commitment to oneself, society, and the natural environment.

Applying the Model to a Mechanical Engineering Course

After developing their theoretical model, the researchers applied it to a mechanical engineering class offered at the University of Georgia, in the form of in-class activities aimed at helping students to relate more empathically with others.

The Engineering and Society class for mechanical engineering students at the University of Georgia involves a series of group-based design challenges that ask students to frame problems within complex, socio-technical contexts. The four empathy modules for this class aim to provide students with 'contextually relevant

opportunities to experience and explore the entire conceptual space of empathy as a skill, practice orientation, and way of being', in ways that enable students to later apply what they learned in their work.

Each of the modules includes a set of structured exercises that are drawn from pedagogical traditions in social work, adapted to fit the engineering context. These modules focus on the following topics: encountering others with genuineness, self-awareness and emotion regulation, affective responding, and synthesising prior exercises while learning to switch between analytic and empathic modes of communication.

The students complete group activities related to body language, proximity, or communication, and are given examples of real-life scenarios to practice their skills in an engineering-related context. After each module, they are asked to write guided reflections about what they have learned, prompting introspection and consolidation of the main learning outcomes.

Student Responses to the Modules

Throughout the modules, the researchers collected student accounts about their experiences. They also made classroom observations and acquired feedback from instructors. These data were later used to conduct research on students' engagement with the new course material, as well as how they came to understand the role of empathy in engineering through the class experiences.

To examine students' interpretations of empathy in engineering, the researchers used Alfred Schutz's social phenomenology framework, which focuses on intentional relationships, or meaning making in interactions, with other humans and with non-human objects, placing them within a meaning-context. Intentional relationships observed in the collected data were placed into three categories: those between the Self (i.e. the students) and Learning, the Self and Others, and the Self and Content.

The students reported experiencing varying levels of disconnect between their expectations of what an engineering learning environment should be like and the exercises they completed as part of the empathy modules. Some students were able to accommodate these experiences, while others found it hard to reconcile them with what they assumed engineering education should be like. In terms of their relationship with others, students' accounts were very complex and diverse, relating to both others in the classroom and non-present 'others'.

One student who participated in the empathy-related modules said: 'It seemed like you didn't want us to solve the problem and just make small talk', expressing a perceived dissonance between what he felt an engineering class should convey and what was covered by the modules. While some students struggled with the empathy exercises, many felt that they had somewhat challenged their views, prompting them to engage with other people's perspectives, consider their feelings, and observe the bigger picture.

In a post-module reflection, another student wrote: 'As an engineer, this activity made me realise how important listening can be. Engineers are required to communicate well, and this means more than just working around problems. With attentive listening, responses come naturally, and in the future I will try to be a better listener rather than just a problem solver.'

Fostering STEM-Related Skills

Drs Walther, Miller, and Sochacka's research has important implications for engineering education, highlighting the potential benefits of integrating empathy-related material within engineering courses.

Teaching engineering students how to be empathic could ultimately help them to develop a more ethical, aware, and responsible approach to their profession, which takes into consideration greater socio-economic contexts as well as the perspectives of non-engineers. This could be highly beneficial, as the work of engineers does require excellent technical preparation, but it also hinges upon understanding the actual needs and circumstances of people in society, upon whom their work will ultimately have profound impacts.

Moreover, empathy can facilitate communication with colleagues and collaborators, encouraging more constructive and mutually understanding relationships that will help students to thrive and make the most out of their future work opportunities. Empathy then will also serve to enhance the effectiveness and productivity of teams in the workplace, which can be of great utility to industry.

So far, the empathy project at the University of Georgia has shown promising results and has already served as an example for other educators and academic programs hoping to foster empathy within service-learning and medical-engineering settings.

The researchers have also written several papers about their work, trained other educators on how to apply the modules, and organised engagement activities that prompt further discussion about teaching empathy in the context of engineering.

In the future, Drs Walther, Miller and Sochacka plan to prepare 'how-to' guides for the implementation of their theoretical model in the classroom and organise workshops that encourage further conversations about and research on empathy in engineering.

Meet the researchers

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Dr Nicola Sochacka is the associate director of EETI and co-leads the engineering education research CLUSTER at the University of Georgia (http://education.engineering.uga.edu/). Dr Sochacka's highly interdisciplinary research program is underpinned by a deep appreciation for different worldviews. She works closely with colleagues from across multiple engineering disciplines, as well as the arts, social work, and education on projects related to institutional change, STEAM (STEM + Art) education, empathy, diversity, and reflection. Dr Sochacka's work is supported by over 1.7 million in grant funding, and has been recognised through multiple invited keynote presentations and best paper awards at international and national conferences.

Dr Joachim Walther is the founding director of the Engineering Education Transformations Institute (EETI) in the College of Engineering at the University of Georgia. He conducts research in engineering education and has received over $2.5 million of funding in this area. Dr Walther co-leads a dynamic interdisciplinary research group that brings together professors, graduate, and undergraduate students from engineering, art, educational psychology, and social work. His work has been recognised through numerous university-level, national, and international awards. Most notably, Dr Walther is a recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE), the highest honour bestowed by the United States government on science and engineering professionals in the early stages of their independent research careers.

Dr Shari Miller is the Associate Dean in the School of Social Work at the University of Georgia. She conducts research related to professional education for reflective and effective practice in a sustainable local and global society. Dr Miller's research more specifically focuses on social work education and the culture of the profession, while also placing strong emphasis on inter-professional and trans-disciplinary collaboration in research and in educational innovation. She has garnered over $4 million in research and training grants in this area, and her work has been recognised through a number of university-level and national fellowships and awards.

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FUNDING

US National Science Foundation (NSF)

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