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Conceptual Framework for Empathy as a Teaching Practice in Engineering Education

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Conceptual Framework for Empathy as a Teaching Practice in Engineering Education

Abstract

This theoretical paper will introduce a conceptual framework for empathy as a teaching practice to improve engineering students' educational experiences. As engineering education strives to meet the industry demands for qualified individuals, it is imperative to address the persistent retention problem in engineering programs, particularly for those individuals from marginalized groups [1]. Research suggests that building connections between students and faculty can play a critical role in shaping a positive academic climate [2].

One strategy for building rapport between faculty and students is to incorporate empathic concern as a teaching practice in engineering courses. Empathic concern refers to the motivational and behavioral components of empathy that are often interpreted as care or concern [3]. This form of empathy is a foundational component in building helping relationships and has positive impacts when integrated into classroom environments [4,5].

This paper explores how the broad concept of empathy is applied in engineering education and guides faculty through the theoretical foundations of empathy as an interpersonal skill. We will introduce three forms of empathy – cognitive, affective, and behavioral [3,6] and highlight three components of empathic concern (understanding, non-judgment, and compassion) that are used in forming helping relationships [7]. An integrated conceptual framework is presented as a tool to support the application of empathy as a teaching practice in engineering education. By understanding and incorporating empathy into their teaching practice, faculty can improve engineering students' educational experiences and further students' persistence to graduation.

Background

Engineering education has long struggled to warm the "chilly climate," particularly for individuals of marginalized groups [1]. In addition, a focus on rigor and meritocracy places an emphasis on fairness and survival culture [8]. As we work to broaden participation in engineering, we must look for ways to warm the culture and shift from a surviving to a thriving mindset. Research suggests that academic climate, specifically inadequate teaching and an individualistic culture, plays a critical role in the attrition of students in STEM fields [9]. Further, to support the success of marginalized students, advocates call for changes to address large-scale cultural issues that can lead to academic burnout and emotional exhaustion [1,6].

To address these challenges, several studies explored the value of student-professor relationships in fostering supportive learning environments. Work by Micari & Pazos [10] found that students who had a positive relationship with faculty earned higher grades and were more confident in their ability to succeed in academically rigorous courses. Vogt [3] explored the impact of faculty-student interactions on students' self-efficacy, academic confidence, and critical thinking skills. Findings from this study suggest that an increased connection between faculty and students significantly improved all three areas. As part of a qualitative study by Hong & Peter [11], students reported positive relationships with professors concerned about students' future

goals, learning, and well-being. These studies provide evidence for the importance of faculty-student relationships and their potential to support the success and retention of engineering students.

However, engineering faculty may not recognize the vital role of rapport and relationship building in supporting their students' success within their courses. A review of expressions of care in higher education found that students often focused on interpersonal rapport with faculty, while faculty focused on their intellectual and instructional roles [12]. Vogt [3, p. 27] suggests, "Ongoing educational reforms must encourage engineering professors to understand the significance of their student-professor relationships and seriously undertake measures to become more personally available to students ." Within engineering education, there is limited research to date that proposes a model for faculty to build these relationships with students. As such, we must go outside engineering education literature and look to more broad perspectives in helping professions, such as education and medicine, to guide this work.

Looking outside engineering education literature, we see many examples of empathy as a tool to build relationships. Rogers [7] highlights empathy as a necessary tool for building helping relationships in therapeutic settings, while Goleman [9] emphasizes the importance of empathy as business and leadership skill. Within educational settings, empathy and care are recognized as critical skills of educators to support positive interactions with students of diverse backgrounds [13]. Further, research by Cooper recognized empathy as a critical part of a teacher's professional identity and an essential practice in “recognizing the worth and value in each individual, valuing difference and promoting tolerance” [14 p. 87]. Finally, faculty who demonstrate empathy develop stronger rapport with students, which leads to improved engagement and course attendance [12]. The application of empathy and care in helping professions, specifically education, suggests that it could be used as a tool to create inclusive environments and support diverse student populations within engineering courses.

In exploring the application of empathy in educational environments, we recognize that they are referring to the behavioral form of empathy, also known as *empathic concern*. This form of empathy refers to the outward expression of care or concern [3] which predicated using cognitive and affective forms of empathy [8]. Gaining a deeper understanding of the various forms of empathy (1) cognitive, (2) affective, and (3) behavioral and their relationship to the components of empathic concern (understanding, non-judgment, and compassion) used to build helping relationships will help support faculty in implementing empathy as a teaching practice in their courses.

Empathy in Engineering Education

Before exploring empathy as a teaching practice, it is important to acknowledge the growing body of work around empathy in the engineering education field [15]. Early work on empathy in engineering measured empathy as a component of an engineer's emotional intelligence. In particular, measures of students’ empathy found that physics and computer engineering students had significantly lower empathy than non-engineering students [16]. These studies suggest that engineers have the opportunity to develop empathy as an interpersonal skill to advance their professional success.

Empathy has more recently been recognized as a critical professional skill in support of engineering design work. As such, there are a growing number of curricular initiatives to support the development of engineering students' empathy as a design skill [14]. These initiatives span a variety of approaches, including stakeholder engagement in human-centered design, service-learning projects, and curriculum on ethical impacts of our engineering work [18]. However, within engineering, students identified empathy as a critical interpersonal skill for building relationships in their everyday lives, yet struggled to see how empathy is involved in their engineering work [19]. This disconnect highlights the importance of emphasizing empathy as not only an engineering design skill, but also as a necessary interpersonal skill.

Further, work by Strobel et al. [20] explored perspectives of empathy from engineering faculty and practicing engineers. On one hand, engineering faculty perceived empathy as an inherent part of the engineering profession [20]. At the same time, practicing engineers recognized empathy and care as a leadership and management skill necessary to building critical workplace relationships [21]. These perspectives reiterate the disconnect between perceptions of empathy in industry and engineering education. While current initiatives to introduce empathy as a design skill in engineering are critical, the contrast between perspectives suggests an additional need to introduce empathy as an interpersonal skill for relationship building. Faculty have an opportunity to model this skill in building relationships with students.

Defining Empathy

Empathy is a multifaceted construct with broad applications across many fields, including neuroscience, medicine, teaching, and psychology [6]. Research in 'helping professions, such as nursing, social work, and teaching, suggests that empathy plays an important role in building relationships and understanding individuals different than ourselves [22]. The concept is often interpreted as being able to “step into someone else’s shoes" or the capacity to understand what another person is experiencing from within that person's frame of reference [19].

Early studies suggested that empathy is an inherent trait or disposition we are born with [22]. However, more recent studies suggest that empathy is a skill that can be strengthened through conscious training [22]. Within helping professions, such as teaching and nursing, empathy is often developed as a professional skill through conscious training in cognitive processes and communication practices [23]. Within business, empathy has become an essential skill in management and leadership and is emphasized as part of the Harvard Business Review Series on Emotional Intelligence [4]. These professions recognize empathy as critical to their professional practice and have emphasized professional development to strengthen this crucial interpersonal skill.

Forms of Empathy

Within the overarching concept, empathy can be grouped into three forms, including (1) cognitive, (2) affective, and (3) behavioral [22]. The cognitive form allows us to understand a perspective outside our own. While the affective form of empathy allows us to understand another individual’s feelings or emotions. [24]. The behavioral form of empathy is what may

lead someone to respond compassionately to another person's distress [4]. Each of these forms of empathy are related but distinct.

Within engineering, professionals recognized cognitive and affective empathy as the skills needed to understand another's perspective, and behavioral empathy, or care, as the action or behavior of "looking out for the well-being of someone else" [21, p. 221]. Behavioral empathy, in particular, draws on our response to another person's well-being and is connected to prosocial behavior and altruistic motivation [25]. These motivations play an important role in prompting individuals to express understanding and act compassionately toward others [4]. This outward expression of empathy is most commonly recognized by others.

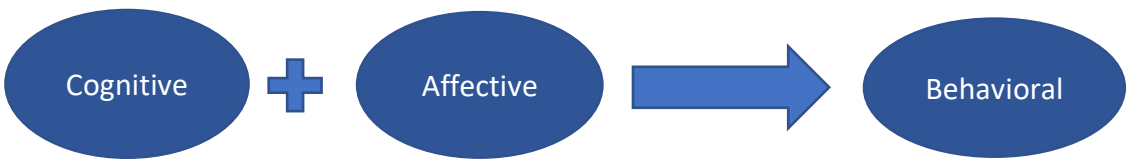
Empathy researcher Jamil Zaki conducted an extensive literature search to explore how these three forms of empathy are represented throughout the literature [25]. These forms of empathy and their associated terms are outlined in Table 1.

Table 1: Terms Used to Describe Forms of Empathy (Adapted from Zaki, 2017)

	Researcher				
Forms of Empathy	Zaki & Ochsner (2012)	Davis (1994)	Baron-Cohen & Wheelwright (2004)	Baston (2011)	Bloom (2017)
Cognitive	Mentalizing	Perspective Taking	Cognitive Component		
Affective	Experience Sharing	Personal Distress	Affective Component	Personal Distress	Empathy
Behavioral	Prosocial	Empathic Concern	Sympathy	Empathy	Compassion

It should be noted that cognitive and affective components of empathy are used to understand an individual's situation and emotions. These forms of empathy serve as antecedents to the behavioral form of empathy. Figure 1 illustrates the relationship between these forms of empathy.

Figure 1: Forms of Empathy



Empathic Concern

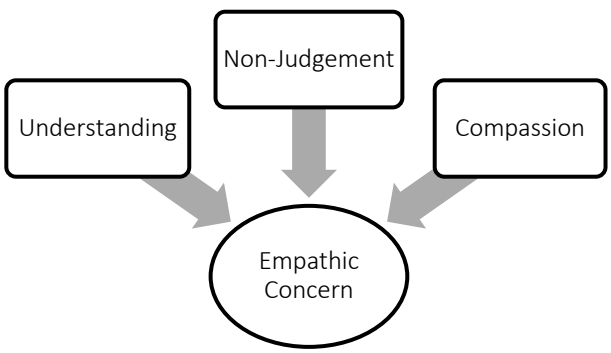
To further develop a model for empathy as a teaching practice in engineering education, we explore *empathic concern* in helping relationships through the lens of Carl Rogers' work in psychology and psychotherapy [4,7, 26]. This theory of empathy emphasizes the importance of expressing care or concern toward individuals in building helping relationships. In this work, Rogers suggests three critical components to expressing empathic concern: understanding, non-judgment, and compassion [26].

First, *understanding* includes the forms of cognitive and affective empathy that are considered antecedents of empathic concern and allow an individual to "see the world as others see it." Rogers emphasizes that this is an active process required to deeply understand another individual's perspective [25]. This component of empathy relies on ability to implement cognitive and affective forms of empathy. As faculty, we must use these skills to step into our students' perspectives.

Second Rogers emphasized the importance of *non-judgment* to allow for putting aside one's own perspectives and biases in order to be open to another individual's perspective. This means that in forming helping relationships, one must not judge the situations, feelings, or actions expressed by the individual they are helping [7]. Non-judgment helps create a space where individuals can safely share their feelings or needs [7]. Wispe [27] further emphasizes non-judgment in describing empathy as "the process whereby one person tries to understand accurately the subjectivity of another person without prejudice" [p. 320]. This is particularly important for engineering faculty working with students with backgrounds different from our own.

Finally, Rogers highlights *compassion* as the form of empathy as the outward expression of care or concern. Goleman describes this expression of empathy as an ability to sense what another person needs from you and a willingness to act on that sense [4]. Compassion is the component of empathic concern most easily recognized by our students. However, it is difficult to enact this component of empathic concern without already practicing the components of understanding and non-judgment. Both components of *non-judgement* and *compassion* leverage the behavioral form of empathy.

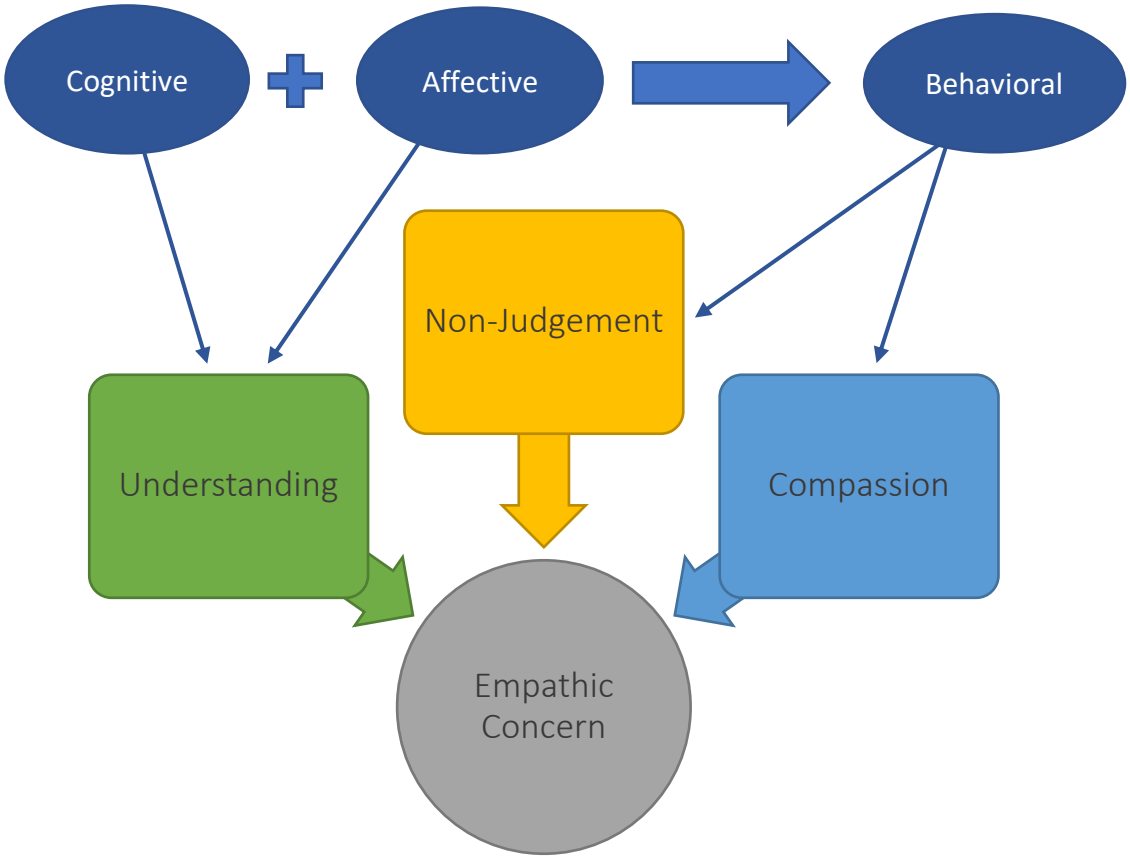
Figure 2: Components of Empathic Concern



Conceptual Framework for Empathy as Teaching Practice in Engineering Education

In developing a conceptual framework to guide empathy as a teaching practice in engineering education, we propose the integration of the forms of empathy (cognitive, affective, and behavioral) with the components of empathic concern necessary to support helping relationships described by Rogers (understanding, non-judgment, and compassion). This framework aligns with the descriptions of passive forms of empathy (cognitive and affective) and the active components of behavioral empathy described by Baston [6], and empathic concern described by Rogers [26]. In particular, this framework highlights the interdependent nature of the three forms of empathy and the components of empathic concern. These interdependencies are illustrated in Figure 3, where cognitive and affective forms of empathy feed into the component of understanding, and behavioral forms of empathy support the components of non-judgment and compassion.

Figure 3: Conceptual Framework for Empathy as a Teaching Practice in Engineering



Examples:

To help illustrate the application of this model within the context of engineering education, two example scenarios of faculty-student interactions are provided in Tables 2 and 3 below. These examples are based on data collected as part of a study of engineering student perceptions of empathic concern expressed by engineering faculty [28].

Scenario 1:

As faculty, you notice that a student in your senior engineering design course seems off. While they were previously active and engaged with their group, they missed several team meetings and seemed distracted and distant. In general, they look rather distraught. You take time to check in with them after class, and the student becomes flustered and emotional. As part of your conversation, you uncover that the student is dealing with several personal issues outside their coursework.

Here is how the framework for empathy could be applied in this scenario:

Table 2 – Scenario 1 Application of Empathy as a Teaching Practice

Form of Empathy	**Component of Empathic Concern**	**Faculty Perspectives or Actions**
Cognitive	Understanding	You recognize the students' perspective of feeling overwhelmed and in distress
Affective		You recall the feelings of a time when you felt *anxious* or *worried* about family or personal issues
Behavioral	Non-judgment	Setting aside your own perspectives of the situation and student, you respond non-judgmentally to the student's emotional response
	Compassion	You take the time to genuinely listen to the student, acknowledge their emotions, and emphasize that you care about their well-being You are aware of campus resources and refer the student to other offices on campus where they can find additional support If needed, you work with the students to adjust the timeline and deadlines for their work

Scenario 2:

In your first-year design course, you are eager to wrap up the first phase of your design project. As you announce that the major deliverable for this phase will be due on Wednesday, you notice a murmur in the room as students turn to talk to one another. You ask the class what is going on and learn that several mid-terms (Calc 1 and Chemistry) are also happening on Wednesday.

Here is how the framework for empathy could be applied in this scenario:

Table 3 – Scenario 2 Application of Empathy as a Teaching Practice

Form of Empathy	**Component of Empathic Concern**	**Faculty Perspectives or Actions**
Cognitive	Understanding	You recognize students' perspectives, including the workload and stress of an engineering student
Affective		You recall being in a similar situation and feelings of being *overwhelmed* and *frustrated* by your workload
Behavioral	Non-judgment	By responding positively to questions and encouraging students to raise concerns you have created a non-judgmental space where students feel safe
	Compassion	You review the course schedule and recognize that pushing the due date back to Sunday will not impact the progress of the course You prioritize students learning material over assignment due dates You acknowledge the challenges of being an engineering student learning new and complex ideas

These examples are reflective of the way Meyers [29] operationalized empathy in teaching:

> *The degree to which instructors work to deeply understand students' personal and social situations, feel caring and concern in response to students' positive and negative emotions, and communicate their understanding and caring to students through their behavior (p. 2).*

It should also be noted that these actions do not lower the standards or expectations for our students. It is important to clarify the distinction between sympathy and empathy. Empathy is not

making things easier for students but ensuring the resources are available for a student to succeed. Meyers suggests that lowering student standards would be acting in sympathy, where an individual feels pity or sorrow for the other person and will take necessary actions to mitigate their suffering [29]. Instead, Meyer suggests empathy focuses on understanding, non-judgmentally, an individual's context and providing support without compromising their standards [29]. In the scenarios described above, the material, expectations, and assignments are maintained at a high level while also providing flexibility to accommodate personal situations. This is a critical differentiation when considering the application of this framework of empathy as a teaching practice in engineering education.

Conclusion:

Understanding and applying a conceptual framework for empathy in engineering education allows faculty to integrate this strategy as part of their teaching practice. Specifically, applying empathic concern can support the development of helping relationships and positive rapport between students and professors. These relationships are significant in fields such as engineering, where increases in student-teacher connectedness can support student engagement, retention, and self-efficacy.

Faculty who can recognize and enact cognitive, affective, and behavioral forms of empathy will be more likely to connect with students on a personal level. Specifically, implementing empathic concern in the form of understanding, non-judgment, and compassion can support the development of helping relationships within engineering education [26]. This strategy reflects many of the best practices in the broader field of education and, when applied to engineering education, has the opportunity to support retention and success, particularly of marginalized groups.

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