

# Fostering Empathy in Computing Education: Insights from IEEE CS 2023 and a Tertiary Software Management Course

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## ABSTRACT

### CONTEXT

This research paper examines the integration and assessment of 'Empathy' within the context of university-level education, by focusing on the IEEE CS 2023 curriculum, and a specific case study of a Software Processes and Project Management subject. By integrating empathy into educational curricula, the study supports United Nations' Sustainable Development Goals SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth) by preparing students for a more inclusive and empathetic professional environment.

### PURPOSE OR GOAL

Despite empathy being recognized as a crucial skill for professional success (as outlined in the World Economic Forum 2023 report), it is not mentioned as a core learning outcome in the IEEE CS 2023 curriculum or in the handbook of the case study subject. This paper presents alternative contextual indicators of assessing empathy, thereby revealing how empathy is subtly integrated into subject learning outcomes, and its potential implications for broader educational practices.

### APPROACH OR METHODOLOGY/METHODS

The study utilized a document analysis methodology to evaluate how empathy is integrated into educational practices. Data was collected from analysis of the (i) IEEE CS 2023 curriculum and (ii) teaching resources from a case study software processes and project management subject at the University of Melbourne (including the subject handbook), focusing on lecture materials, tutorial contents, and assessment criteria. This data was analysed to identify indirect indicators of empathy within the context of this single project management course offered at the tertiary level.

### ACTUAL OR ANTICIPATED OUTCOMES

The study reveals that while empathy is not explicitly listed as a core learning outcome in the IEEE CS 2023 curriculum or the case study subject's handbook, students are exposed to empathy through indirect means, as seen from the lens of professional practices adopted in the industry. These professional practices demonstrate how empathy can be embedded within technical courses taught in the university, even if not directly stated in the learning outcomes.

### CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The findings suggest that universities may need to recognize and formally assess such alternative indicators of empathy to enhance the alignment of educational outcomes with the skills required in professional settings. This approach highlights the importance of integrating empathy into curricula more explicitly to better prepare students for real-world challenges.

### KEYWORDS

Empathy, Curricula, Software Engineering Education, Case Study, Software Processes, Software Project Management, Tertiary, Computer Science

## Introduction

While there is a diversity of definitions for the term 'Empathy' (Hall & Schwartz, 2019), generally 'Empathy' can be thought of as the ability to immerse oneself in the perspective of another individual, facilitating a comprehension and mutual sharing of their emotions, thoughts, and experiences. This often engenders a sense of compassion and a proclivity to provide assistance or support (Kalisch, 1973). Empathy is more often assessed as a combination of subjective experiences and communicative abilities, and often categorized as 'Emotional Empathy' (the ability to feel a different person's emotion) and 'Cognitive Empathy' (translating the feeling into words and actions) (Decety & Jackson, 2004).

The "The Future of Jobs Report" released by the World Economic Forum (2023) identifies 'Empathy' as one of the top 10 core skills for workers, underscoring its critical importance in the modern workforce. Empathy enhances collaboration, drives innovation, and improves customer relations by fostering a deeper understanding of diverse perspectives and emotional needs. As automation and artificial intelligence continue to transform industries, empathy remains a uniquely human skill that enables effective teamwork and leadership, making it indispensable in navigating complex, dynamic work environments. This recognition of empathy's value highlights the need for its deliberate integration into educational curricula, particularly in fields like computing and software engineering, where technology intersects profoundly with human experience.

The importance of empathy has been discussed in several contexts. For example, while empathy has been argued as being critical and essential for effective social work (Gerdes & Segal, 2011), it is also critical and a central component to successful outcomes in counselling and therapy (Feller & Cottone, 2003). Interestingly, there are varied opinions about the importance of empathy to nursing. While there are multiple studies that attest to the indispensability of empathy to the nursing practice, there are studies that argue about '*Sympathy*' and '*Compassion*' being better effective and suited to a nursing context as compared to empathy (Fernandez & Zahavi, 2020). Moreover, empathy is a critical quality for leadership. '*Empathetic leadership*' is grounded in the belief that human interconnections and empathy are foundational to societal resilience. Empathetic leaders cultivate emotional connections to respond to the needs of both their team members and customers. By leveraging individual talents and diverse perspectives in problem-solving, leaders foster environments conducive to trust, transparency, and collaboration (Tzouramani, 2017). More recently, the role of Empathy in Engineering Education has been discussed in (Wilson & Mukhopadhyaya, 2022), and as a core skill and professional way of being in Walther et al. (2017). Empathy as being critical to outcomes in engineering design education is argued for in the research of Alzayed et al. (2021), Afroogh et al. (2021), and Wong et al (2016).

The Computer Science Curricula 2023 Report (Kumar et al., 2024) (henceforth referred to as the CS 2023 Report), released in January 2024 by the Joint Task Force on Computer Science Curricula—comprising the Association for Computing Machinery (ACM), IEEE-Computer Society (IEEE-CS), and the Association for the Advancement of Artificial Intelligence (AAAI)—is a comprehensive document that outlines seventeen knowledge areas reflecting the ongoing advancements in computing since the publication of the first curricular guidelines over fifty years ago. Each knowledge area consists of multiple knowledge units encompassing related topics. The document delineates the minimum essential topics, termed 'CS Core' areas, that every graduate must master, as well as 'KA Core' areas that recommended for in-depth study within each knowledge area.

Furthermore, the report addresses the outcomes for each knowledge area from both a knowledge model (focused on course content) and a competency model (focused on learning outcomes). These models provide complementary perspectives on the learning continuum, emphasizing both content and outcomes. For each knowledge area, the report details the adaptable values, beliefs, and attitudes necessary to foster desirable workplace behaviours among engineers. These critical skills, which employers highly value for workplace success, are referred to as 'Professional Dispositions' in the CS 2023 Report.

Professional Dispositions like empathy should not be narrowly defined but rather viewed through a multifaceted lens that considers their complex application in educational contexts. To effectively integrate and assess dispositions like empathy within university courses across disciplines such as computer science, information systems, information technology, and software engineering, a broader and more nuanced interpretation is required. This nuanced approach should be based on broad indicators that can explicitly cultivate and assess empathetic skills, over and above their definitions and types as outlined previously. Fostering a nuanced interpretation of empathy will help to assess how these skills are fostered among students in tertiary studies.

Given the increasing recognition of empathy as a core skill essential for the modern workforce, it is imperative to examine how educational curricula, particularly in fields like computer science and software engineering, integrate and articulate empathy as a learning outcome. The CS 2023 Report, as a cornerstone for academic programs in computer science, offers a pivotal framework for embedding such critical skills. Assessing the extent to which this curriculum includes empathy will provide valuable insights into its alignment with the demands of the contemporary job market. But, given the nuanced nature of empathy, an analysis of its presence in educational contexts is essential. An understanding on how existing topics and learning activities in specific university courses align with fostering empathy will shed light on practical approaches to cultivating this skill among students. This research aims to explore and address the following research questions:

### **Research Question(s):**

1. To what extent does the IEEE CS Curricula 2023 articulate empathy as an intended learning outcome or area of learning?
2. To what extent does teaching resources in SWEN90016 – Software Processes and Management Subject articulate empathy as an intended learning outcome or area of learning?
3. What already existing topics and learning activities in SWEN90016 – Software Processes and Management course align with fostering student skills for empathy?

## **Methodology**

To address RQ1, the CS 2023 report was analysed using the document analysis technique (Bowen, 2009). Drawing from the definitions and types of empathy discussed in the Introduction section, a list of keywords related to empathy was created (Table 1). The authors engaged in iterative discussions to ensure a comprehensive representation of empathy-related concepts (Table 1) that captures the nuances of cognitive, affective, and emotional empathy. The contents of the CS 2023 report were then deductively searched using these keywords to evaluate whether these keywords appeared in the report, what was the frequency, and what was the contexts (or which parts of the report) which mentioned each respective keyword.

To address RQ2 and RQ3, a case study of a single mandatory coursework subject ' SWEN90016 – Software Processes and Management ' (SWEN90016, 2024) for all post graduate students enrolled in the Master of Information Technology and the Master of Software Engineering courses at The University of Melbourne is presented.

For RQ2, documents relevant to the mandatory coursework subject SWEN90016 were analysed using document analysis technique (Bowen, 2009). Documents included the subject handbook, teaching materials, class activity instructions, and each of the assessment tasks. Each of the documents were deductively searched using each of these keywords present in Table 1. The frequency count for each keyword was calculated, and the contexts (or which documents) mentioned each respective keyword were reported.

For RQ3, the teaching activities and assessment tasks from SWEN90016 were reviewed using the Expert Review method. In Expert Review, a single expert with extensive knowledge and experience in a particular field systematically reviews documents, data, or other materials to provide insights, or recommendations based on their expertise. The expert is the first author, who draws from over 16 years of industry experience as a technology consultant involved in all phases of the Software Development Life Cycle (SDLC) for Fortune 500 clients. The purpose was

to identify software engineering activities which are covered in the subject that intrinsically have aspects of tasks, or topics that can be directly related to empathy, when referring to the keywords listed in Table 1. There may be software engineering activities that students are already doing that arguably may be developing empathy skills, but it is not directly stated in the subject documents or intended learning outcomes. In this process, we explore whether the primary focus on teaching and assessing other learning areas can also serve as contextual indicators of empathy. This analysis will help determine if existing educational practices effectively foster empathy, or if there is a need for more explicit integration of empathetic skills in the curriculum.

## Results and Discussion

### RQ1: To what extent does the IEEE CS 2023 curriculum articulate empathy as an intended learning outcome or area of learning?

The purpose of Table 1 is to provide a representation of how often terms related to the context of empathy appear in the CS 2023 Report. We employ Thematic Analysis to identify empathy-related indicators listed in Table 1. The choice of terms was informed by established research frameworks. For example, Davis's Interpersonal Reactivity Index (IRI) and the Questionnaire of Cognitive and Affective Empathy (QCAE) emphasize the '*cognitive*' and '*affective*' dimensions of empathy, which support the inclusion of these terms (Davis, 1983; Reniers et al., 2011). Similarly, Baron-Cohen's (2004) empathy framework references '*understanding*' and '*compassionate concern*', thereby aligning well with the selection of indicators used for our analysis. A consensus on these indicators was reached between the authors through expert judgement.

By counting the occurrences of these specific words, the table aims to highlight the emphasis placed on empathy and its various indicators within the context of computer science education. This analysis helps in understanding the extent to which the report acknowledges the importance of empathy-related skills, such as understanding others' perspectives and sharing their feelings, in the curriculum.

The outcome of the analysis undertaken on the CS 2023 report (Table 1) is presented below.

**Table 1: Words Related to Empathy identified from the literature, and the frequency of the words within the CS 2023 Report**

Word Related to Empathy	Description of the Word	Number of Occurrences
Empathy	Direct mention of empathy or related concepts.	5
Cognitive	References to cognitive empathy, understanding others' perspectives.	16
Affective	References to affective or emotional empathy, sharing others' feelings.	2
Emotional	References to affective or emotional empathy, sharing others' feelings.	3
Feelings	References to affective or emotional empathy, sharing others' feelings.	0
Concern	References to affective or emotional empathy, sharing others' feelings.	33
Understanding	References to affective or emotional empathy, sharing others' feelings.	88
Compassionate	References to compassionate actions or attitudes.	0

The outcome of the document analysis undertaken on the IEEE CS 2023 Report (Table 1) is presented below. 'Empathy' as an outcome is only mentioned under the Human Computer

Interaction (HCI) Knowledge area in 5 places. The report mentions the use of Empathy Maps as an important tool to aid in a user centered design methodology to deal with the knowledge units that deal with understanding the user in an HCI design process. The report also mentions the importance of describing empathy and its evaluation as key elements in the design process. More importantly, one of the key Professional Dispositions for an HCI practitioner is to be empathetic and demonstrate an understanding of the user needs.

The term 'Cognitive' finds a mention in this report in 16 places. This term is discussed in various contexts that do not relate to 'Cognitive Empathy' but rather to distinct learning areas and outcomes. With reference to 'AI-Agents: Agents and Cognitive Systems' Knowledge Unit under the 'Artificial Intelligence' Knowledge Area, in the context of agent architectures, 'Cognitive' refers to types of architectures such as reactive, layered, and cognitive, indicating a focus on different methodologies for structuring intelligent agents. Moreover, 'Cognitive' is also discussed in reference to cognitive systems and their architectures, such as ACT-R, SOAR, ICARUS, and FORR, emphasizing the study and application of these systems in understanding and modeling human cognition. The term also appears in the evaluation of cognitive systems, specifically in constructing an intelligent agent using well-established cognitive architectures like ACT-R and SOAR to solve specific problems, highlighting a practical learning outcome centered on the application of cognitive theories. Lastly, with reference to 'HCI-User: Understanding the User: Individual goals and interactions with others' Knowledge Unit under the 'Human Computer Interaction' Knowledge Area, the term 'Cognitive' is discussed within topics in social and behavioural psychology, such as cognitive biases and change blindness, focusing on understanding human perception and behaviour rather than empathy. In each of these instances, the term 'Cognitive' is seen to have been linked to distinct educational contents pertaining to specific learning objectives and outcomes in the realm of computer science and psychology, rather than relating to cognitive empathy.

The same observations can be made with reference to the term 'Affective' is discussed in the context of educational outcomes and learning areas (Knowledge Unit 'HCI-Evaluation: Evaluating the Design' under the Knowledge Area 'Human Computer Interaction') by the virtue of its mention in the report in 2 places.

Similarly, the term 'Emotional' is mentioned in 3 places. In line with the observations made previously, this term is not presented as an indicator of Empathy, but rather in a generic sense or specific course outcome (such as the impact of computing applications on wellbeing and safety of all kinds including emotional safety in the Knowledge Unit 'SEP-Context: Social Context' under the Knowledge Area 'Society, Ethics, and the Profession (SEP)'). On similar lines, the term 'Concern' and 'Understanding' occurs in 33 and 88 instances respectively in the report, largely argues as an indicator of Intended Learning Outcomes across multiple knowledge units and knowledge areas, but not in the context of Empathy. Finally, there is no mention of the terms 'Feelings' or 'Compassionate' in the report.

## **RQ2: To what extent does teaching resources in the SWEN90016 Subject articulate empathy as an intended learning outcome or area of learning?**

Based on the first authors' industry experience as well as our combined experience of teaching this subject, we argue that professional and interpersonal skills such as teamwork, stakeholder management, and conflict resolution (to name a few) are critical in the software engineering field expected of college graduates to demonstrate. This alignment with industry expectations attests to the importance of this research question to both academic and professional stakeholders. These skills are also a core focus area of the learning outcomes in SWEN90016. These skills inherently require empathy, as understanding and responding to the perspectives and needs of diverse stakeholders is central to effective project management. Thus, SWEN90016 is a suitable subject for analysis to explore how empathy is represented in teaching materials.

Table 2 analyses the extent to which empathy is articulated as an intended learning outcome within the teaching resources of SWEN90016. By examining the frequency of terms related to empathy in different teaching activities such as lectures, assessments, learning objectives, and

discussion forums, we assess how explicitly empathy is integrated into the educational framework of the case study subject. This analysis helps in determining whether and how the subject emphasizes the development of empathy-related skills among students.

The outcome of the analysis undertaken on SWEN90016 materials (Table 2) is presented below.

**Table 2: Frequency Count of the terms in Table 1 that are articulated in the SWEN90016 Subject teaching materials**

Activity	Description	Number of Occurrences
Lectures	Contexts where empathy is part of teaching material	No mention
Assessment	Contexts where empathy is assessed such as through peer feedback, or assessment outcomes.	No mention
Learning Objectives	References to empathy in learning objectives or goals. Assesses statements of educational goals, indicating whether and how empathy is a targeted outcome of the course.	No mention
Discussion Forum	Any mention or description of discussion forums used in the course. Analyze areas where student interactions occur, which can be analysed to see how empathy is encouraged through peer discussions.	No mention

It is interesting to note that during the evaluation of the subject teaching materials to identify the occurrence of the keywords in Table 1, we did not find any mention of these terms as they relate to Empathy or different types of empathy, mentioned directly in the teaching materials. But students are indirectly exposed to empathy (as a by-product of the main learning outcomes), further discussed, and elaborated as a part of Research Question 3.

**RQ3: What already existing topics and learning activities in a software and IT project management course align with fostering student skills for empathy?**

As mentioned in Research Question 2, we did not find any terms that directly dealt with Empathy or their related types in the case study subject. But Empathy in a professional context can be observed through project management activities that align with needs and interests of the client and the key stakeholders. The empathy indicators identified and discussed below are relevant to understanding diverse perspectives, addressing concerns, and communicating effectively, which are core components of empathy in professional practice. As these areas are central to the intended learning outcomes of SWEN90016, it makes this subject a strong candidate for analyzing how empathy-related skills may already be fostered implicitly.

Moreover, SWEN90016 is a mandatory foundational course in the curriculum that introduces students to software and IT project management, making it crucial for shaping foundational professional skills, including empathy. Other subjects might address such skills differently or less explicitly, so understanding how existing learning activities align with fostering empathy is essential. This ensures that empathy skills are either reinforced in subsequent courses or need to be articulated more clearly across the curriculum.

The following examples were identified from the teaching activities of the SWEN90016 subject, that can be argued as being linked to empathy.

**Stakeholder Analysis**

*Description:* Stakeholder analysis involves understanding and addressing the needs and concerns of all individuals involved in a project. This activity inherently involves empathy, as project managers must grasp and address the needs and concerns of all the stakeholders.

*Relevance to Empathy:* A critical project management activity is Stakeholder Management. This involves identifying and managing key stakeholders, who are essential to the project's success.

By recognizing stakeholders' needs and managing them appropriately, the activities of the project managers reflect Cognitive Empathy (by understanding stakeholders' perspectives), and Emotional Empathy (by addressing their needs concerns). For example, when a project manager listens to a client's concern about potential disruptions during a project, they demonstrate understanding of the client's perspective and emotional state, thereby highlighting cognitive empathy. Similarly, by considering a team member's workload and offering support to prevent burnout, the project manager exhibits emotional empathy through their actions.

*How this is covered in the subject:* The course dedicates lecture discussions to the intricacies of stakeholder management, emphasizing the importance of establishing and maintaining strong relationships with stakeholders. This aspect of the curriculum demonstrates Cognitive Empathy through the understanding of stakeholders' perspectives and Emotional Empathy by addressing their needs and concerns. Agile SDLC principles discussed in the lectures further reinforce this by advocating for customer collaboration and continuous engagement, aligning with the empathetic approach towards end-users. More importantly, the context of this activity is discussed in about 70 places considering the lecture materials and the final exam scenarios.

### **Requirements Analysis**

*Description:* The process of actively listening and adapting to client feedback through iterative negotiation and communication, to understand and prioritize their needs and vision for a project.

*Relevance to Empathy:* One of the crucial phases of any software project is Requirements Engineering. Here, professionals work with clients to understand the envisioned value and the integral requirements for project success. This iterative process of eliciting, negotiating, and refining requirements demonstrates Empathy. It involves understanding and prioritizing the client's needs, thereby embodying Cognitive Empathy (by comprehending the client's perspective) and Emotional Empathy (by valuing and addressing their concerns).

*Where is this covered in the subject:* While requirements analysis is not the focus of this subject, the importance of this critical activity in the context of its applicability in Software Development Life Cycles, and by extension the successful outcome of the project is seen in the data from multiple lecture materials. More importantly, the context of requirements is discussed in about 108 places in the lecture materials. By understanding and prioritizing the client's needs, students learn to appreciate the client's perspective and address their concerns effectively.

### **Risk Management**

*Description:* This process involves identifying, evaluating, and mitigating potential risks to ensure the project's success, demonstrating an understanding of, and concern for the client's needs.

*Relevance to Empathy:* Risk Management is another activity where Empathy is evident. A risk management exercise (focusing on identifying, evaluating, and mitigating risks that could adversely impact the project), reflects a concern for the project's success and, by extension, the client's needs. By continually monitoring and adapting risk response strategies, project managers demonstrate Cognitive Empathy (through foresight and planning), and Emotional Empathy (by striving to prevent negative outcomes for the client).

*How this is covered in the subject:* Risk management is another critical area covered extensively in the course. The lectures and assessments highlight the iterative process of identifying, analyzing, and mitigating risks, showcasing an empathetic concern for the project's success and, by extension, the client's needs. The learning outcomes demonstrates Cognitive Empathy through foresight and planning, and Emotional Empathy by striving to prevent negative outcomes for the client. The inclusion of case studies and practical examples in both assignments and exams allows students to apply these concepts in realistic scenarios, further embedding empathy into their professional practices. Therefore, it is not surprising that the context of Risk and Risk Management is discussed in about 126 places in the lectures, assessments, and the final exam.



## Other Observations

The course assessments and the final examination are designed to reinforce these empathetic practices. Students are required to discuss various risks and stakeholder management strategies in the context of case studies, demonstrating their understanding of how empathy plays a crucial role in successful project outcomes. Discussions and FAQs in the course forum further emphasize the importance of these practices, providing students with a holistic understanding of how empathy is integrated into project management.

## Summary and Implications for Educators

Empathy is expected of professional graduates to succeed in the workplace. However, our study demonstrates that the CS 2023 report does not explicitly indicate empathy as a skill within many of its knowledge areas. Likewise, empathy is not listed as an intended learning outcome in the handbook or teaching materials of the case study subject discussed in this research paper.

However, our study demonstrates that empathy can still be effectively taught and assessed in the university setting through alternative contextual indicators from the workplace. In our analysis, we identified that empathy, although not explicitly mentioned, is inherently imparted to students as a by-product of the primary learning outcomes in the case study course. SWEN90016 focussed on emphasising critical project management activities like stakeholder management, risk management, and requirements engineering (in the context of their importance to the choice of software development life cycle models based on the stability of requirements), all of which inherently involve empathetic practices.

The professional practices of requirements engineering, stakeholder management, and risk management are intrinsically linked to empathetic practices. These activities require students to understand and address the needs and concerns of clients and stakeholders, thereby fostering both cognitive and emotional empathy.

This indirect method of teaching empathy highlights the need for universities to recognize and formally assess such alternative indicators of empathy in all disciplines (such as computer science or software engineering, where the primary focus areas are more technically or subject-focused instead of critical soft skills like empathy). By doing so, they can readdress the focus of intended learning outcomes in subjects to emphasize the importance of empathy in a professional setting. This re-evaluation could also lead to the development of separate courses dedicated to cultivating empathy, reflecting its significance as outlined in the World Economic Forum Report 2023.

Our research has established a foundational step in this direction by showcasing a professional perspective with three alternative indicators of empathy in our case study subject. This approach reveals that empathy is being taught and assessed in a more subtle and nuanced manner in the university. Recognizing and formalizing these indirect methods of teaching empathy could better prepare graduates for the collaborative and dynamic nature of modern workplaces, where empathy is an indispensable skill.

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