# Open Questions for Empathy-Building Interventions for Inclusive Software Development

Kyle L-Messerle, Samuel Malachowsky, Daniel E. Krutz
Department of Software Engineering
Rochester Institute of Technology, Rochester, NY, USA
{klm3580, samvse, dxkvse}@rit.edu

**Abstract**

Research has demonstrated that much of the software being created today is not sufficiently inclusive, unbiased and equitable. This has been found to frequently result in real-world implications such as prejudice against women or people of color, and software that is inaccessible to people with disabilities. Preliminary research has found that empathy-focused experiential educational activities can be beneficial for not only creating empathy, but in advancing the participant's interest and knowledge retention over traditional non empathy-building interventions. This work will provide a foundational background on the current research in the intersection of experiential learning and empathy-building interventions in computing education. We will also present several important questions that still must be explored, thus serving as the foundation for future work in this area.

## 1 Introduction

Research demonstrates that we continue to be deficit in creating inclusive and equitable software [6, 13, 15, 55, 80]. Despite the prevalence and demonstrated capabilities of experiential education [1, 36, 46, 89] and foundational demonstrated benefits of empathy-building interventions [3, 45, 52, 85], the intersections of these topics have not been sufficiently explored [52]. Specifically, we need to investigate and create educational empathy-building interventions to better inform and motivate students to create more inclusive and equitable

software. There are several key areas that require further exploration. These include:

1. Understand the benefits and impacts of empathy-creating interventions in experiential computing education.
2. Recognize appropriate methodologies to include empathy-creating interventions in experiential computing education.
3. Understand if experiential empathy creating interventions can help to reduce bias.

Improved knowledge regarding empathy-creating interventions can directly benefit computing education while exponentially benefiting society through the creation of more fair, unbiased, and inclusive software used by the general population [63, 73, 83]. Potential benefits of empathy-building experiential education modules can contribute to the foundational understanding of experiential education from a theoretical and practical perspective, benefiting a variety of topics in computing education (*e.g.,* general computing, accessibility, artificial intelligent/machine learning, autonomy, software engineering, HCI, etc.).

The rest of the paper is organized as follows: Section 2 provides the motivation and guiding theory, while Section 3 presents related works. Section 4 discusses several important crucial questions to be addressed and Section 5 provides a conclusion.

## 2 Motivation and Guiding Theory

**Motivations from Education:** Experiential empathy-creating interventions have been explored in various non-computing domains such as in medicine [31, 44, 57, 87], and for creating tolerance in social situations [18]. Unfortunately, the application of these benefits in experiential computing education is inhibited by a lack of understanding regarding: I) A proper implementation framework [79], II) Their specific pedagogical advantages, and III) The most appropriate pedagogical and technical methods for integrating these into computing curriculum [58]. The potential benefits of empathy-building interventions in experiential computing education has been demonstrated in foundational, preliminary research [52]. Despite these encouraging results, there is currently a lack of knowledge that inhibits the implementation and benefits of empathy-creating interventions at institutions across the United States [38, 52, 63].

The application of empathy-building interventions in experiential computing education has been inhibited by both pedagogical and technical limitations [52]. The hypothesis that creating empathy can increase student interest is supported by the PI's preliminary work in this area [52]. Deeper pedagogical questions also exist, such as appropriate intervention inclusion methods and

their impacts on empathy's subprocesses ('mentalizing', 'experience sharing', 'empathic concern') [3,25,40,85,91]. Additionally, technical obstacles must be overcome such as how to properly create an empathy-building experience and how to sufficiently emulate the experiences of other users (*e.g.,* accessibility challenges, racial bias, etc.).

**Motivations from the Community:** A lack of empathy among software developers has been attributed to the creation of biased, inequitable software [6,24,58]. This necessitates the creation of high-quality empathy-creating educational interventions to support the next generation of software developers in creating more equitable software for society. Research has demonstrated that increasing empathy can lead to software that is developed in a more accessible, inclusive and equitable manner [7,52,88]. This prior work provides confidence that improving empathy in computing students can yield similar benefits and help them to understand the necessity of creating inclusive software. Unfortunately, there is a lack of an understanding of how to most effectively teach students empathy-related concepts to construct inclusive software. While bias may be created due to unconscious developer actions or by non-human factors (*e.g.,* incoming data in AI/ML [24,77]), an objective should be to better understand how participants can more appropriately become cognizant of, and properly address biases when developing software.

Recent US government legislation has called for software that is more inclusive and unbiased [20,24,65,66,77]. There is also a stated educational demand for easily adoptable interventions that will support the creation of more equitable software, such as software that is created with a greater amount of empathy [6,17,61]. Increased empathy is expected to result in the creation of software that is more inclusive, equitable and unbiased [58], while also having a positive impact on the developer's career [42]. Empathy is being seen as a greater necessity due to the increasingly globalized nature of society [58]. The demand for software with these attributes will continue to grow as more interactions and tasks are performed online [12,69]. Preliminary observations [52] have demonstrated that the proposed work has the capability to directly contribute to accomplishing these goals.

**Guiding Theory:** Research demonstrates that we continue to be deficit in creating inclusive and equitable software [6,13,15,35,39,55,80]. Prior work has demonstrated that increased empathy can lead to software that is developed in a more accessible, inclusive and equitable manner [7,52,88]. Empathy can be developed, frequently through experiential activities [3,21,45,52,85,86]; however, there are no known efforts to examine the integration of experiential learning to create empathy in computing education [52,85]. Existing works have demonstrated both the capabilities of experiential learning [1,36,46,89] and in empathy creation [3,21,45,85,86]. It is surmised that this increased

empathy will increase the student's ambition to create more equitable and inclusive software.

**General Scientific Barriers:** A key challenge is how to accurately create experiential empathy-creating interventions for both instruction and evaluation in a variety of computing courses, ranging from foundational to more specialized courses. While initial work demonstrates the foundational capability of empathy-creating interventions in several offerings of a CS2 course [52], it has not been widely attempted in other computing curriculum. Although there are various proposed empathy measuring evaluations [32, 33], there do not appear to have been any significant efforts for measuring empathy in computing education, representing another challenge that must be addressed. Ensuring that interventions create empathy and not pity for specific users is another challenge that must be considered.

**Preliminary Efforts:** Foundational work has demonstrated the potential benefits of experiential empathy-creating interventions [52]. Using a pre-and post-lab survey analysis involving 276 Computer Science 2 (CS2) students, dependent t-tests indicated that empathy-creating interventions increased student feelings that developing accessible software is important. While far from a definitive study, this observation demonstrates the foundational capability of empathy-creating interventions in experiential computing education. Existing works have demonstrated both the capabilities of experiential learning [1, 36, 46, 89] and in empathy creation [3, 21, 45, 85, 86]. However, there are no known significant efforts to examine empathy-creating interventions in experiential computing education.

## 3 Related Work

### 3.1 Experiential Education

Experiential learning is commonly used in many educational topics [1,36,46,89] and has routinely demonstrated its benefits [9, 48, 49]. Experiential learning provides a complete learning experience for the student, one where they both understand the concept behind an idea and interactively learn about it [10]. Compared to alternative teaching approaches such as lectures, experiential learning has been demonstrated to be more engaging for students [54], and supports student retention of information [41, 78]. The four stages of Kolb's Experiential Learning Cycle [50] include 'Concrete Experience,' 'Reflective Observation,' 'Abstract Conceptualization,' and 'Active Experimentation.'

### 3.2 Empathy-Building Interventions

Research demonstrates that people frequently fail to empathize with a particular target group because they are unwilling to empathize [74, 90]. Fortunately, research suggests that empathy can be developed, frequently through experiential activities [3, 21, 45, 52, 85, 86]. An identified challenge in driving people to empathize are 'avoidance motives' which make empathizing more of a difficulty [29, 47, 51, 59]. An example of an avoidance motive is when people believe that addressing empathy-created concerns will be too costly [16, 67, 75] or painful [26]. Therefore, when striving to create empathy, it is imperative to demonstrate how empathy will align with, and not obstruct the project's goals [37, 75]. There are generally at least three related, but distinct subprocesses that comprise empathy [85]. 'Mentalizing' is the ability to draw inferences about a target's feelings and thoughts. 'Experience sharing' is when a person vicariously experiences another person's emotional state [40]. 'Empathic concern' focuses on a perceiver's desire to alleviate the target's distress [2]. There are several forms of empathy, including *cognitive*, *emotional*, *affective*, and *somatic* [19, 43, 60, 76]. This work will primarily focus on cognitive empathy since it is the form that is most amiable to a computing-oriented experiential environment.

There are two primary forms of empathy interventions, *Experience-based* and *Expression-based* interventions. Experience-based interventions often allow the perceiver to encounter a scenario through the target's perspective using either a hands-on or theoretical activity. This form of intervention has been traditionally used to build empathy through a deeper understanding of the target's thoughts and feelings [85]. Examples of such interventions involve medical students staying in a hospital overnight to experience a hospitalization from a patient's perspective [87], or asking participants to imagine life and feelings of a member of a stigmatized group [4]. Expression-based interventions teach participants to recognize the internal states of the participant and respond appropriately. These interventions are frequently implemented in scenarios where it is difficult to identity distress in others, or when a perceiver is impaired in conveying empathy for a target [85]. Expression-based interventions have been used in a variety of areas, such as in medical students identifying when a patient is in pain [5, 71], and helping autistic adolescents improve their affective empathy by recognizing emotional traits in others [23, 34].

## 4 Open Questions

There are several key questions that should be addressed in order to better understand the intersection of experiential learning for building empathy.

**1. Understand the benefits and impacts of empathy-creating interventions in experiential computing education:** Although there have been a large amount of existing research that demonstrates the benefits of experiential learning [1, 36, 46, 89] and empathy-building interventions [3, 21, 45, 52, 85, 86], there is far less work that examines the intersection of these two important topics, especially in computing education [52]. We hypothesize that empathy-creating interventions in experiential computing education will increase student interest, motivation and information retention, which are crucial for retention and encouraging students to pursue STEM careers [56, 84]. We also hypothesize that increasing empathy for diverse users will support students in understanding the need to create more equitable software. An additional question to be explored are the potential benefits of experiential vs expression-based interventions.

A better understanding of the potential benefits of empathy-creating interventions in experiential computing education can be attained using short interventions and t-tests. Measured variables may include motivation, interest and knowledge retention. A primary consideration is to ensure that a properly diverse group of students (*e.g.,* demographics, experience levels, etc.) are included in any such evaluation.

**2. Recognize appropriate methodologies to include empathy-creating interventions in experiential computing education:** There are several potential methodologies that may be taken to both evaluate and include experiential empathy-building interventions in computing education. We argue for small, self-contained and easily adoptable modules and interventions that can be utilized at institutions across the United States. We hypothesize that these short interventions will support the inclusion and subsequent evaluation of these topics, as short self-contained interventions have demonstrated their effectiveness in numerous other computing educational areas [64,72,81]. We believe in reasonably brief (*i.e.,* $\approx$ 30-60 minute interventions) since foundational computing courses are typically already packed with topics and that many institutions (especially those that are resource constrained) will not have the ability to develop entire courses focusing on this area.

**3. Understand if experiential empathy creating interventions can help to reduce bias:** Forms of bias include prejudice, stereotypes, affective reactions, and discrimination [30]. Bias comes in many shapes and forms ranging from overtly bias human beings, to algorithms that unintentionally contain bias [24, 77]. The adverse impacts of bias continue to be detrimental, despite the cause.

There has been a substantial amount of work to address bias and prejudice [14, 22, 53, 70], and studies that demonstrate the potential benefits of experiential-based interventions in addressing bias [11, 62, 68, 82]. However,

there are no known significant efforts to evaluate or demonstrate the impact of empathy-creating interventions in computing education in addressing prejudice.

A primary challenge will be how to effectively measure bias since it occurs both unconsciously and intentionally [8,27]. Additionally, even if a student does recognize their own bias, they may be unlikely to truthfully admit any notions of this on a survey instrument. To address this challenge, a participant's bias could be implicitly measured, using mechanisms such as understanding affective reactions using Likert-scales to measure the range of experienced emotions [28], along with evaluating the produced artifact (*e.g.,* source code, algorithm, etc.) for aspects of bias or prejudice. These measurements could be evaluated in settings such as conventional classrooms, outreach events or small group activities using instruments such as pre-post test measures.

Despite the challenges of measuring bias, we believe that this continues to be an important and worthwhile area that warrants further exploration. This is due to the potential benefits that can be provided from the knowledge produced from further understanding how to reduce bias.

## 5 Conclusion

Experiential education has demonstrated its benefits in a wide variety of application areas. Additionally, empathy-building interventions have demonstrated their foundational capabilities in preliminary research [52]. Unfortunately, there is a significant amount of research in important areas that intersect these topics that still need to be explored.

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