

Human-Empathy Accessibility Learning (HEAL) intervention model towards critical soft skills development for career readiness among computing undergraduate students

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Abstract

This pilot mixed methods study explores the impact of Human-Empathy Accessibility Learning (HEAL) interventions on soft skills development in undergraduate computing students, emphasizing their role in job readiness and perceived employability. HEAL interventions aimed to enhance accessibility awareness, focusing on motivation, empathy, and emotional intelligence. Participants were assigned to control and experiment groups, with qualitative findings showing empathetic growth in the experiment group. Quantitative results partially supported qualitative findings, indicating statistically significant changes across measures. Despite quantitative limitations, short-term empathy interventions showed potential benefits for job readiness. The study discusses implications of mixed findings and recommends future research directions.

Keywords: *Empathy; Accessibility; Soft skills in Computing Education; Emotional Intelligence; Employability, Motivation.*

1. Introduction

The modern workplace demands soft skills such as adaptability, empathy, and collaboration (Chhinzer & Russo, 2017; Deming, 2017; NACE, 2024; Tejan & Sabil, 2019). While disciplinary knowledge remains relevant, interpersonal and self-management abilities are crucial for graduates to thrive (Bridgstock, 2009; Chan et al., 2017). Emotional intelligence, motivation, and empathy are foundational competencies (Andrews & Higson, 2008) that enable positive social interactions, teamwork, leadership, and adaptability (Dacre Pool & Sewell, 2007; Kiss et al., 2022; Rao, 2010).

Despite recent advancements in soft skills research within computing education, there is a lack of studies examining how targeted accessibility awareness interventions can enhance emotional intelligence (EI), motivation, and empathy among undergraduate computing students (Cotler et al., 2019) and their impact on perceived job readiness and employability (Becker & Mentz, 2019; Deming & Noray, 2020; Moses et al., 2023; Messerle et al., 2023). This study evaluates changes in EI, motivation, and empathy before and after the Human-Empathy Accessibility Learning (HEAL) intervention at two U.S. institutions: a small liberal arts college and a large, tier 1 technical research university (R1). HEAL emphasizes practical skills, knowledge, and empathy development to create accessible software solutions and fosters an inclusive mindset in future computing professionals.

This study aims to explore research questions related to the impact of the HEAL interventions on undergraduate computing students. Firstly, it investigates whether the HEAL interventions result in measurable changes in empathy and motivation among the participants. Secondly, the study assesses attitudinal changes in inclusive perspectives among the college students involved in the intervention. Lastly, the research examines the influence of these attitudinal shifts on students' perceived employability, as this is a crucial factor in their future success as computing professionals. By addressing these inquiries, our research intends to shed light on the advantages of empathy-focused education in computing programs. The findings of this study would contribute to the development of technical professionals who are more compassionate, inclusive, and empathetic, qualities that are increasingly valued in today's diverse and dynamic workforce. Furthermore, the insights gained from this research can inform the design and implementation of future interventions aimed at fostering soft skills and accessibility awareness among computing students, ultimately leading to more inclusive and user-centered software solutions.

2. Methods and Materials

2.1. Study Design and Participants

This mixed-methods pilot study comprehensively investigates the impact of Human-Empathy Accessibility Learning (HEAL) interventions on undergraduate computing students' empathy, emotional intelligence (EI), motivation, perceived employability, and attitudes towards accessibility at a small liberal arts college and an R1 technical university. Qualitative measures captured the nuances and complexities associated with the interventions, as strict experimental control is challenging in educational settings.

HEAL offers ability simulations focused on sight and hearing impairments, shifting the focus from disability to ability. By showcasing the potential of individuals living with disabilities,

HEAL challenges stereotypes and promotes a more inclusive view of accessibility, minimizing the risk of psychological harm associated with traditional disability simulations (Olson, 2014).

Participants were divided into a control group and two intervention groups that participated in an "empathy lab," featuring stations for learning assistive technologies. Table 1 details the study's sample distribution, highlighting self-selected participation from both institutions, with all participants being computing majors.

Table 1. Sample Distribution: Spring 2023

Interventions	Institution A – HEAL	Institution B – HEAL	Institution B – Control
Total number of participants	31	14	25
Gender - female	39%	21%	12%
Gender - male	61%	79%	88%

2.2. Qualitative Measures

A six-question reflection was distributed at both institutions after gaining ethics approval at both research sites. The reflections asked about Q1: Attitude and Perspective Change, Q2: Skills Acquired, Q3: Immediate Changes Planned, Q4: Future Approach to Design, Q5: Professional Applications, and Q6: Workshop Feedback. The reflections were administered after each intervention.

2.3. Quantative Instruments Used

Pre- and post-quantative intervention assessments were conducted using the Perth Empathy Scale, the Trait Emotional Intelligence Questionnaire (TEIQue), the Work Motivation Scale, and a question about perceived employability. Pre-Interventions were administered at the start of the semester and again at the end of the semester. These instruments were administered via Qualtrics to each student in the study.

The Perth Empathy Scale is a validated, 20-item self-report measure that assesses cognitive and affective empathy, including their valence-specific aspects. It gauges the accurate recognition of others' emotions (cognitive empathy) and emotional resonance with others (affective empathy) for both negative and positive emotions. The scale comprises four subscales, each with five items, without the need for reverse-scoring, adhering to recommended practices (Brett et al., 2023). Both cognitive and affective empathy are essential for effective interpersonal interactions.

The TEIQue-SF (Trait Emotional Intelligence Questionnaire - Short Form) is a validated 30-item measure of global trait emotional intelligence, crucial for understanding emotional processing and interpersonal dynamics (Petrides, 2009; Petrides & Furnham, 2006). It assesses key aspects of emotional intelligence, including well-being, self-control, emotionality, and

sociability, which are essential for empathy and communication. The TEIQue-SF's straightforward design and focus on evaluating emotional perception, management, and expression make it well-suited for studying inclusivity and understanding in technology design.

The Multidimensional Work Motivation Scale (MWMS) is a 20-item validated psychometric assessment (Gagné & Deci, 2005) that measures intrinsic and extrinsic motivation, relevant for this study as it helps understand an individual's workplace drive and commitment, key factors in technological design and development. With four subscales and no reverse-scoring, it is an efficient tool for evaluating motivational aspects crucial to the study's focus.

2.4. Statistical Methods and Data Analyses

The data were analyzed using paired samples t-tests to compare pre- and post-intervention measurements for both the experimental and control groups. Normality of the pre- and post-intervention differences was confirmed using the Shapiro-Wilk test. Equality of variances was confirmed using Levene's test.

3. Results

Qualitative data analysis was conducted for the interventions. It revealed a Kappa score of 0.69 signifying a substantial agreement between the evaluators. Table 2 presents the outcomes of the Empathy Lab workshop at two institutions, identifying key themes and providing sample quotes from participants. The table showcases a collective emphasis on empathy, soft skills such as teamwork, importance to employability, and motivation for incorporating accessibility features across both institutions.

3.1 Comparison of Data at Institution A and B (Empathy Lab)

Table 3 provides a comparison of qualitative data between the two Institutions (A is the large R1 technical university and Institution B is the small liberal arts college) regarding the impact of accessibility interventions. While both institutions reported positive outcomes from the accessibility workshops, there were differences in the nature of the changes observed. Institution A had a more diverse attitude change and focused on technology specific aspects, while institution B primarily experienced changes centered around empathy and had a strong specific technical improvement. Both institutions expressed a strong commitment to implement changes and transformed their outlooks for future approaches and professional application of the intervention content, albeit with varying emphases.

Table 2. Main Themes by Institution

	Institution A – Empathy Lab	Institution B – Empathy Lab
Main Themes Discovered	Designing with Empathy Creating Accessible Products Accessibility Features Importance to Career Teamwork Skills	Empathy Development Motivation for accessibility in design Emotional Intelligence Importance to Career Teamwork Skills
Sample Quotes (some excerpted)	<p>"I now have a better knowledge of the impact of technology on persons with disabilities, as well as the role I may play in facilitating change."</p> <p>"...the website examples helped me realize how helpful screen readers are when it comes to navigating websites and how important it is for screen readers to work on every website."</p> <p>"I developed the skill of being able to put myself into someone else's shoes and try to navigate a task through their eyes."</p>	<p>"...helped me understand how important it is to do your research to see how other people experience things."</p> <p>"As a result of this, I plan on being a greater advocate for making sure that any project I work on is accessible."</p> <p>"I will apply this to my professional life by informing others about using techniques that help with accessibility."</p>

Table 3. Comparison of Qualitative Data

Questions	Institution A	Institution B
Attitude and perspective change	71% reported a change with more diverse focus	93% reported change mostly centered around empathy
Skill development	16% reported on gaining soft skills	71% reported on gaining technical skills
Intention to implement changes	100% agreed with more distributed focus	100% agreed with strong emphasis on revising alt tags and color contrast
Future approaches	97% positive about changes focusing on tech-specific aspects	100% positive about changes with focus on tech- and people-specific aspects
Application in professional life	69% application for inclusion	93% concrete plans for implementing changes
Workshop effectiveness	87% effective workshop	78% useful workshop

In summary, both workshops were effective in changing attitudes and imparting skills related to accessibility and inclusion, but they differed in focus. Institution B had a more emphatic and holistic impact on participants, while Institution A offered a more technical, diverse set of learnings. Both had almost unanimous agreement on the need for practical changes in design and future approaches.

Quantitative analysis marginally supported the positive post-intervention qualitative responses, revealing a more pronounced increase in empathy levels, motivation and perceived employability. Overall, the control group showed no significant changes from pre- to post-intervention on any measure. For Institution A, the only statistically significant change was an increase in wellbeing post intervention. Institution B showed a borderline significant decrease in perceived employability. While most comparisons were non-significant, some measures showed small-to-medium sized effects that may be noteworthy but did not reach statistical significance. For example, Institution A showed small-to-medium increases in cognitive empathy, affective empathy, and overall empathy, while Institution B showed small increases in cognitive empathy, emotionality, and motivation.

4. Discussion

The qualitative analysis revealed that all participants expressed a commitment to integrating empathetic insights from the training into their current and future design efforts, highlighting the vital role of empathy in creating accessible technology and preparing students for STEM careers. Participants reported increased empathy, motivation, and EI, and the hands-on approach enhanced their technical skills and sense of responsibility towards creating universally accessible products. Feedback emphasized the effectiveness of the interventions in transformative learning and nurturing STEM professionals with a focus on empathy, motivation, and EI in design and development.

However, the quantitative findings did not show robust, statistically significant changes in empathy, EI, and motivation, which could be attributed to the short duration of the interventions and the complexity of altering these skills in a brief period. Despite this, the study yielded marginally significant results and trends in subjective well-being and perceived employability for some experimental conditions, while no changes were observed in the control groups. The interventions led to marginal improvements in students' mental and emotional state and inspired enhanced motivation..

Unexpectedly, students participating in the interventions showed a trend towards decreased confidence in their job prospects compared to controls. This could be due to students gaining a deeper understanding of the diversity of needs and perspectives in the workplace, highlighting skills gaps and areas requiring further development. However, this awareness could ultimately better equip students to improve these skills and be more confident in addressing workplace

diversity once given time to process the information. Providing adequate time for reflection and skill-building after exposing students to diverse perspectives could help transform uncertainty into greater adaptability, empathy, and confidence. Further research should explore the nuances of how empathy interventions impact student confidence over time.

5. Future Research

Future research should build on these mixed findings by examining specific intervention components and their effectiveness in improving subjective well-being, perceived employability, motivation, EI, and empathy. Investigating the impact of extended or repeated interventions over a longer duration, as well as longitudinal follow-up with participants after graduation, could help assess the long-term effects on career success and the integration of accessibility practices in the workplace. Additionally, larger sample sizes, multiple intervention groups, and tailored interventions for different demographics or learning styles should be explored to determine best practices and improve outcomes for specific student subgroups. Researchers should also investigate the optimal timing, frequency, and format of interventions to maximize their impact. Finally, future studies should combine robust quantitative measures with in-depth qualitative data collection through interviews, focus groups, cognitive walkthroughs, and observational data to gain a multidimensional perspective on how empathy interventions shape students' skills and mindsets. Pursuing these research avenues can help refine HEAL interventions to optimize their impact on building computing students' soft skills, empathy, and readiness for diverse workplace environments.

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