The Equity Effects of Micro-Messaging in Computing Learning Environments

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Abstract **–** The longstanding underrepresentation and attrition of minoritized racial and ethnic groups and women in computing courses, majors, and careers continues to plague researchers, educators, and policymakers alike. Informed by Sue and colleague's microaggression framework and Rowe's microaffirmation framework, this study theorizes identity-related factors that undermine and support efforts to increase the representation and meaningful participation of minoritized racial and ethnic groups and women in computing education. We conclude with implications for teaching practices to advance equity, inclusion, and justice in computing education.

Keywords: computing education, STEM equity, unconscious bias, microaggressions, microaffirmations

I. Introduction

The underrepresentation and attrition of minoritized racial and ethnic groups (MREs) and women in computing courses, majors, and careers is chronic and longstanding. This underrepresentation is the most tangible manifestation of disparities in experiences and outcomes in STEM introductory courses required for computing degrees [1], discrimination, and racial and gender bias [2, 3], and unwelcoming STEM learning environments that signal cues of stereotype threat, exclusion, and inferiority, particularly for racial and ethnic minority students, and women [1, 4]. These systemic barriers negatively affect computing interest, self-concept, and persistence in computing education and careers.

Broadening participation in computing education and the tech workforce has been deemed a national priority in the US and an essential goal of the scientific community [2, 5, 6]. Despite strategies and programmatic efforts to increase the representation of MRE students and women in computing, the lack of diversity in computing courses, majors, and careers persists.

A rich stream of research has identified how negative social contextual factors such as unconscious bias, cultural stereotypes, prejudice, discrimination, racism, and microaggressions serve as barriers that perpetuate inequities in computing learning environments and persist in the workplace [2, 4, 7]. Less emphasis has been placed on an emerging stream of research that focuses on the positive social contextual factors such as microaffirmations that serve as conduits for counteracting microaggressions and stereotype threat [4, 7].

Informed by Sue et al.'s microaggression framework [8] and Rowe's microaffirmation framework [9], the purpose of this research-in-progress is threefold. First, we examine how microaggressions serve as barriers perpetuating disparities in persistence, retention, and computing identity at a Predominantly White Institution (PWI). Next, we discuss how microaffirmations serve as conduits for supporting persistence, retention, and computing discipline identity at a PWI. We conclude with implications for teaching practices to advance equity, inclusion, and justice in computing education.

II. Background

Stigmatizing experiences in the form of microaggressions are common occurrences for women and MRE students in STEM learning environments [2]. Microaggressions are manifestations of unconscious bias, cultural stereotypes, and assumptions about intellectual merit [7]. For example, researchers have found MRE students at PWIs have been exposed to learning environments that signal cues of aggression and exclusion [4]. Moreover, researchers have found that STEM learning environments in US universities do not consistently provide kindness cues that affirm social inclusion and validate the dignity of all students [4]. The absence of kindness cues negatively affects students' engagement, psychosocial experiences, sense of belonging, persistence, and retention.

A. Microaggressions

Chester Pierce originally coined the term microaggressions based on his experiences in the 1960s [10]. Microaggressions are brief intentional or unintentional, micro-messages that communicate hostile, derogatory, negative slights and insults to an individual or group [7, 8]. Sue and colleagues [8] built upon Pierce's research by developing a theoretical framework comprising three sub-forms of microaggressions: microassaults, microinsults, and microinvalidation. *Microinsults* are micro-messages that convey rudeness and insensitivity, demeaning an individual's heritage or identity. *Microassaults* are conscious

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and deliberate micro-messages intentionally meant to degrade and harm an individual. *Microinvalidations* are micro-messages that exclude, negate, or nullify the experiential reality of an individual from a marginalized group. The destructive impacts of microaggressions are more pronounced for MREs and women who have repeatedly experienced bias and microaggressions in STEM learning environments.

B. Microaffirmations

During a study of mentoring programs published in 1973, Mary Rowe coined the term microaffirmations [9]. Microaffirmations are brief, intentional or unintentional, effective micro-messages that convey inclusion, support, and affirmation to individuals or groups who may feel unwelcome or invisible in an environment [7, 9, 11]. Importantly, these small acts of microaffirmations counteract the adverse effects of microaggressions wherever people wish to help others succeed.

Rowe developed a theoretical framework comprising three sub-dimensions of microaffirmations: microcompliments, microsupports, and microvalidations. *Microcompliments* are subtle micro-messages that convey praise, admiration, and respect for an individual's identity and lived experience. *Microsupports* are intentional micro-messages that provide feedback and scaffold resources to support an individual who may feel unwelcome or invisible in an environment. *Microvalidations* are micro-messages that communicate appreciation for the experiences, thoughts, abilities, or feelings of individuals from marginalized groups. In higher education environments, microaffirmations have been found to positively affect student persistence, retention rates, graduation rates, and student satisfaction [11, 12].

III. Research Methods

In 2022, the researchers surveyed undergraduate and graduate students in a college of computing at a large research-intensive PWI in the northeastern US. This survey was part of a continuing effort to assess students' perceptions of the college climate. The researchers designed the survey to capture students' intersecting identities, how these identities shaped their experiences and perspectives regarding belonging and inclusion, and the specific actions taken by faculty and staff that foster and hinder feelings of inclusion and belonging.

The survey was created in Qualtrics and administered at two points in time. In 2020, 191 students completed the survey, and 205 students completed the survey in 2022. The response rate for both data points was approximately 10% of the total student population in the college. The demographics of survey respondents are displayed in Table 1.

	2020	2022
Race and Ethnicity	74 White, 28 Asian, 9 Black, 6 Hispanic	67 White, 48 Aian, 15 Black, 9 Hispanic
Gender	74 Male, 41 Female, 2 Non-Binary	66 Male, 64 Female, 6 Non-Binary
Sexual Orientation	100 Hetero, 14 LGBTQIA	109 Hetero, 15 LGBTQIA
Class Standing	22 Grad, 157 Undergrad	38 Grad, 141 Undergrad
Nationality	109 US, 14 Intenational	104 US, 33 International

TABLE I. Survey Demographics

The researchers used Sue et al.'s and Rowe's theoretical frameworks [8] [9] to code responses to text-based survey questions about students' experiences with inclusion in the college community.

IV. Findings

A. Preliminary Summary of Findings from 2020

In 2020, 133 (82.1%) reported satisfaction with their overall experience of feeling included in the college, 20 (12.3%) were neutral and 9 (5.6%) were dissatisfied. Twenty-nine students responded to the open-ended question, "If you have ever felt excluded from the college community due to your identity, please elaborate on why you felt excluded."

Ten women expressed exclusion based on gender identity. Although no microassaults were reported, microinvalidations were well represented in female students' responses. For example, women reported feelings of isolation. "I wish there were more female inclusive or specific events. I barely know any women in the college." The most common form of microinvalidations were stereotypes about women being less skilled with technology. "Many boys come in having played video games/messed with computers so they might know more, and it can be intimidating when the professors don't take the time to explain stuff that isn't common knowledge for everyone. That part doesn't have to just be for women, but it is something I've noticed bother other girls in my classes."

Women also explained microinsults in the form of a backhanded compliments and having their contributions to group assignments overlooked, devalued, and stolen. One woman explained, "I have had a classmate tell me, point blank after I did his portion of the group project, that he was 'really surprised someone like me (a female) could produce such high-quality work.' Really? Also, it is very obvious that many peers, and sometimes, I think even professors, think of me as the stereotypical 'dumb white girl' from my appearance before I get the chance to show my Honors College intelligence. Often, I feel like I have to prove people wrong because of who I am."

Eleven (9.1%) students felt excluded based on race and/or ethnicity (2 white, 2 Hispanic, 3 Asian, 4 Black). Of those who reported exclusion, 36.4% were Black. Black students also identified the most experiences with microinvalidations based on race. In one disturbing response, a Black student reports significant mental distress when interacting with peers and faculty. "Being a minority within [redacted] is a challenge. People, from students to professors, automatically make assumptions about you, and it's hard to fight against these assumptions. These events have been anxiety-inducing and have made me feel fearful to go to class or to go to group meetings."

Thirty-one (16.2%) students responded to the open-ended question, "In your college classes, what are some actions taken by your faculty that have made you feel included in the college community?" These responses were coded as microaffirmations. Microsupports and microvalidations were the most identified ways that faculty created a culture of inclusion in the classroom. Microsupports allow students to

work in small groups on team projects, which students viewed as a key means of facilitating intercultural communication. However, sharing resources about clubs, events, internships, and professional development opportunities was the most cited form of microsupport.

Microaffirmations, while fewer in number, offer numerous opportunities for building inclusive learning environments. Students mentioned that group work facilitates community building and options to include everyone in conversations. They also noted that bringing current events into the classroom and using inclusive language when facilitating discussion are helpful for all students. Inclusive language in syllabus statements and behaviors, such as reaching out to women, international students, and others from underrepresented groups, fosters belonging in the classroom. Moreover, students appreciated small gestures like learning their names and identity pronouns, sharing events that celebrate diverse cultures, promoting campus services that support students from MRE groups, and posting signage like the rainbow pride flags to express solidarity with students from underrepresented groups.

B. Preliminary Summary of Findings from 2022

In 2022, 117 (82.1%) reported satisfaction with their overall experience of feeling included in the college, 24 (15.8%) were neutral and 11 (7.6%) were dissatisfied. Thirty (14.6%) students answered the open-ended question, "If you have ever felt excluded from the college community due to your identity, please elaborate on why you felt excluded." Students identified gender (10) and racial identity (17) as the primary sources of exclusion. Of these responses, seventeen microaggressions were identified.

A trans woman expressed microinvalidations when pressured to conform to traditional gender norms and being forcibly categorized in ways that did not align with their identities. For instance, "I struggle with the prevailing Sir and Ma'am culture and have reservations about the 'They' pronoun. The rigid association of certain traits and norms with specific genders is frustrating." Trans students also described difficulties working on team projects. "I have a hard time making friends with classmates, and some professors resent me for it."

Consistent with the results in 2020, women also reported feeling isolated, marginalized and belittled in predominantly male classroom environments. These microinsults come from peers and professors. For instance, a woman shared, "The college is overwhelmingly male-dominated. I've encountered numerous instances in classes where, being one of fewer than five women, I've felt isolated or condescended to…" Another wrote, "I wish that professors would stop singling out the women in class when they are trying to increase participation. Even when their intentions are genuine the action feels demeaning."

Those reporting race-based exclusion include 7 Black, 4 Asian, 3 Hispanic and 3 white students. Black students most commonly described microinvalidations stemming from the enduring pressure to sustain high-performance levels, even amidst the emotional turmoil following traumatic events such as George Floyd's death in 2020 and the COVID-19 pandemic. "As a black student, I was treated horrible but [sic] a professor in my college during the time I was terrible ill with COVID-19. The professor deducted grades because I couldn't attend class to present…This professor is inhumane and racist. He also treated, [sic] the one other black student in his class unkind.

Thirty-five (17.1%) students responded to the open-ended question, "Given your identity, what are some actions that you wish faculty in your college classes would take to make you feel more included in the college community?" Seven microaffirmations, predominantly related to microsupports, were identified. Students found that the interpersonal connections fostered by their professors and the course content significantly enhanced their learning experiences. One student appreciated the personal outreach, sharing, "Reaching out to me individually as a student," while another valued the relevance of the course content, stating, "Specifically, two of my professors…made me feel included by teaching content that was relevant to the current trends in technology and other related fields."

Students also noted the powerful impact of professors' affirmations in creating inclusive classroom environments. "One professor asked about our preferred pronouns at the beginning of class," shared one student, and another noted the effort made by a professor to learn every student's name: "Professor [redacted] makes an effort to get to know every student's name." These microaffirmations underscore the profound influence of intentional, inclusive actions by professors on students' sense of Students also noted the powerful impact of professors' affirmations in creating inclusive classroom environments belonging and learning development. [7].

V. IMPLICATIONS FOR TEACHING PRACTICES

In centering the voices of diverse students in computing, this study offers empirical examples of language and behaviors that facilitate and hinder inclusion in learning environments. To create cultures of inclusion in computing learning environments, we provide suggestions for both avoiding microagressions and promoting microaffirmations as well as equitable, inclusive, and effective teaching practices.

First, to avoid microaggressions, we suggest the following practices for adoption:

- *Microassaults* – acknowledge the existence of systemic inequities, gender and racial bias, and discrimination in higher education and adopt practices that combat discrimination and eradiate bias. One approach is to develop equity-minded syllabi containing policies and messages attuned to student experiences around growth mindset, diversity, care, and belonging. Syllabi should also communicate that the class environment is intentionally designed to encourage welcoming and collegial behavior.
- *Microinsults* - Rather than ignoring the existence of bias and discrimination that some in class may have experienced directly or indirectly, discuss this as an aspect of the field and how what is learned in class can help create emotionally supported spaces where

students from all backgrounds and identities feel valued, included, and encouraged to reach their full potential.

- *Microinvalidations* – critically reflect on your own cultural lens and broaden your cultural perspectives. When considering your own cultural lens, you may realize the breadth and depth of your experiences and how many additional experiences your students have had. In addition, leverage growth-minded instructional practices that address identity-threating cues that can send negative message about STEM intelligence and ability, and who can succeed.

Next, to counteract microaggressions, we suggest adopting the following identify-affirmative practices known as microaffirmations:

- *Microcompliments* – recognize student efforts and experience. Using phrases of affirmation when engaging with students such as "great question" and "good work" are meaningful and encourages more positive student engagement.
- *Microsupports* – adopt strategies incorporating growth mindset interventions that impress upon students that skills and intelligence are not fixed but are increased by persistence, good strategies, and quality mentoring. Assignments that encourage persistence through revision offer greater support students than high-stakes exams. Opportunities for students to learn as a group also bolster their ability to give and receive feedback in a structured and supportive manner. Moreover, normalize challenges and promote the use of resources as a standard part of student success.
- *Microvalidations* - Design and facilitate culturally responsive curriculum and practices that emphasize the real-world relevance of computing and societal impacts. Additionally, implementing activities that encourage discussions about students' and scientists' backgrounds and identities provides a space to honor, celebrate, and validate students' lived experiences.

These suggestions are certainly not all encompassing nor a one-size-fits-all way of improving instruction. Rather, they provide additional ways to consider computing education praxis. Finally, we recommend a personal growth trajectory for instructors by educating oneself about microaggressions and their impact on diverse learners. Efforts like this will help to recognize places in which this may exist in your teaching and how you can take steps to intentionally combat racial and gender bias, and cultural stereotypes through identity-affirming strategies such as microaffirmations.

VI. CONCLUSIONS

Microaggressions are subtle, nebulous, and difficult to identify and rectify. However, left unaddressed, faculty unwittingly become complicit in creating negative psychological experiences for students and unwelcoming learning environments. This study examined how microaggressions serve as barriers and how microaffirmations are conduits to inclusive computing learning environments. Despite the limitations due to the low response rate, this study contributes to the literature on equity, inclusion, and justice in computing education by articulating an identity-affirming strategy, microaffirmations, for ameliorating microaggressions in computing learning environments.

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