CTRL + Empower: Lived Experiences of Black Women and Latinas in Computer Science at an Urban Public University

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Abstract— **Among public universities in the New England region of the United States, the University of Massachusetts Boston (UMB) is the most ethnically diverse. Enrollment data in the Computer Science (CS) department there closely aligns with the broader demographic composition of the university, with over half of CS majors identifying as students of color, a trend that deviates from national patterns. However, the department demographics exhibit a gender disparity, with male students outnumbering female students at a ratio of five to one, consistent with both national and global trends in CS. The disparity is even higher when an intersectional lens is applied: attracting and retaining Black and Indigenous Women of Color (BIWOC) students, especially Black and Latina women, in the CS program remains a significant challenge. Here, an exploratory phenomenological case study utilizing participatory action research was conducted to examine the lived experiences of female Black and Latina students in the CS department. A preliminary survey informed focus group topics of discussion. Thematic coding of focus group discussions was undertaken to achieve two objectives: (1) to develop actionable recommendations for improving the recruitment and retention of students of color and women, and (2) establish research experience for the female participants so they may benefit tangibly from their contribution. Key themes identified included resistance to BIWOC students, mostly in the form of questioning capabilities and other microaggressions, background mental labor in responding to or actively ignoring that resistance, navigating the world as it is versus trying to change it for the better, the need for counter-spaces to share experiences of microaggressions and develop success strategies, and potential benefits of a BIWOC research hub, open to all students but with a focus on BIWOC students.**

Keywords—diversity, inclusion, gender, ethnicity, education, women in computer science, intersectionality in computer science

I. Introduction

The University of Massachusetts Boston (UMB) is an urban public research institution serving approximately 16,000 students and employing 1,100 faculty members across ten colleges. Among the 35 higher education institutions in Boston, UMB stands out as the city's sole public research university. It is recognized as the most ethnically diverse public campus in the New England region. Approximately 60% of the university's undergraduate population comprises first-generation college students, many of whom are children of immigrant parents. Additionally, 61% of students who are US citizens identify as students of color (SoC), a representation mirrored within the Computer Science (CS) department.[1] While 55% of undergraduates at UMB identify as female, women remain underrepresented in the College of Science and Mathematics (41%), particularly within the CS department (20%).

Globally and at UMB, there are low rates of application and matriculation, and high rates of attrition, for women in computer science (CS) programs and research [1], [2]. The problem is more pronounced for Black and Indigenous Women of Color (BIWOC), especially those who identify as Black and Latina [3], [4], [5], [6], [7]. These populations of BIWOC students and faculty have proportionally lower rates of participation in CS research projects, which may result in fewer BIWOC succeeding academia, thereby minimizing the presence of BIWOC role models for new students and perpetuating the cycle [8]. The study aimed to inform new initiatives that increase BIWOC matriculation and research participation in CS departments at UMB and beyond. We accomplished that goal by documenting the lived experiences of a group of BIWOC students studying computer science at UMB. Simultaneously, the implementation of Participatory Action Research ensured that in addition to documenting the phenomenological experiences of these women, they will also gain research experience, another step in the direction of their success and increasing the possibility that they serve as role models for future BIWOC students.

[1] Refer to the DISCUSSION section for a detailed discussion of the distinctions between "Students of Color" (SoC) and "Black, Indigenous, and Women of Color" (BIWOC) as they relate to this study. Additionally, departmental data collection does not differentiate between East Asian, Southeast Asian, and other Asian subgroups; instead, all are grouped under the broad "Asian" category. This categorization poses challenges for the study, as many Southeast Asian students identify as people of color, a nuance that is not adequately captured in the existing data framework.

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II. Research Design

A. Research Questions

Overarching question: How may we describe and improve the lived experience of BIWOC students in the CS department at UMB?

Sub Questions:

1. What factors contribute to the underrepresentation of BIWOC students in our CS classes?
2. How can UMB increase recruitment and retention of BIWOC students in the computer science department?
3. How do different cultural elements and personal stories of BIWOC students inform their experiences in our classes?
4. How do BIWOC students see themselves in the future in relation to their participation in the CS department today?

B. Background

We aimed to collect and evaluate data to identify opportunities to improve the experiences of students who are members of groups that have historically been marginalized in the field of computer science: students who identify as women and students who identify as people of color. There are currently no structures in place in our department by which we can examine students' perceptions of classes and coursework with this specific lens. While SoC are well represented on campus and there is a Women in Computer Science club on campus, the continued disproportionality in low enrollment and high attrition rates of BIWOC students indicates that the department can do more to ameliorate the experiences of students who have historically experienced intersectional discrimination due to their gender and ethnic identity. This demographic summary reflects previously researched phenomena in which "Universities have been interested in getting students of color on campus, but have not focused as much on making sure students of color stay and feel welcome" [9]. With the participation of those students themselves, we documented and analyzed the beliefs and opinions of BIWOC students regarding their lived experiences in the CS department. This analysis informed concrete suggestions for our department to implement in the pursuit of strong diversity, equity, and inclusion for our students.

C. Research Methods

The study employed a sequential mixed-methods design, incorporating both quantitative and qualitative approaches. The quantitative component was conducted via document analysis in order examine demographic trends at both the university and CS department levels. Additionally, surveys were utilized to gather numerical and categorical data. On the qualitative side, a focus group was conducted to explore in-depth perspectives and experiences of Black and Latina students in the department with the purpose of lending a more human dimension to the quantitative findings.

These elements combined to form an exploratory phenomenological case study in which we analyzed and compared participant experiences. This approach enabled the researchers to interpret and derive meaning from the lived experiences of students representing diverse backgrounds and gender identities, rather than merely describing them [10], [11]. Participatory action research (PAR) was identified as the most suitable framework for this study, given its alignment with the research questions and the department's goal of integrating historically marginalized student voices into the development of new initiatives. Positioning the lived experience of our co-authors against the backdrop of demographic statistics prioritizes the personalized why and how behind the statistical what of the problem quantification. Our department wanted to highlight the voices of Black and Latina computing students as we simultaneously sought to improve matriculation rates for those populations. Rather than make the women a subject of inquiry, we believe that they themselves are empowered to research the phenomena that affect them. Furthermore, researcher participation in the presentation of the research will itself contribute to higher rates of CS research among historically underrepresented groups.

Survey Instrument design:

Surveys were chosen as the best way to inform and direct conversation and subject matter in the subsequent focus group. With the survey, we aimed to compare various student data points with their perceptions and attitudes towards the CS department as a factor of their lived experience and sense of belonging there. We chose surveys to accomplish that goal since they "[look] at variation in a variable across cases," which helps "to draw causal inferences by careful comparison of the various characteristics of cases" [12]. This quantitative portion of the study informed the subsequent qualitative portion.

Surprisingly, we found no previously published validated instrument that measured intersectional experiences, representation, and sense of belonging specifically in BIWOC students in STEM fields or Computer Science departments at the university level. Much of the research on the examination of underrepresented groups in STEM fields centers on gender or ethnicity. The intersectionality of both gender and ethnicity was key to our study, but seminal studies on the phenomenon of BIWOC students in STEM are relatively few (all published within the last decade) and implemented non-survey instruments of data collection including focus groups [3], [4], viewpoints [6], and research study synthesis [13]. Among those that did use surveys as data sources, some focus on engagement in K-12 girls of color [7], others on sense of belonging in Latinas in high school [14], and others used survey instruments only as pre-experimental tools for recruitment and selection [15].

We therefore created our own survey instrument. The women in the study created the questions that might generate poignant responses in the focus group; these questions were then grouped by theme (Representation, Belonging, UMB CS experience, Awareness of student group on campus, STEM background, Demographics). The "Belonging" section included all 3 questions from the National Survey of Student Engagement "Sense of Belonging" survey from 2020, a rigorously validated instrument considered to have reliable generalizability [16], plus one that the women decided to include ("Please indicate your level of agreement with the following statement: 'I feel like I belong in this department'"). For item-response options, five-point Likert scales were considered to be appropriate for the majority of items on belonging and support, due to their ability to measure varying degrees of feelings and perceptions with strong consistency and construct validity [17].

Preliminary review for face validity was favorable, with the Expert Review feature in Qualtrics assigning a "great" overall score for display logic, piped text, complete translations, valid question types, clarity and conciseness, and optimization for mobile survey takers, among other reviewed issues. Expert review suggested the addition of definitions for terminology that appeared in survey questions such as "micro aggressions" and "first generation college student," which was adopted.

D. Focus Group Recruitment and Composition

A recruitment email was sent to the listserv of all 981 undergraduate students in the Computer Science department. This email encouraged students who identified as women and/or students of color to respond if they were interested in a collaborative research project for and about those populations.

12 students who identified as women and/or students of color responded to the recruitment survey, total. Seven of those respondents identified as Black or Latina women. All seven women were invited to

collaborate and participate in the design and implementation of the research project. All seven students initially participated and completed the survey. Unfortunately, only three women attended the focus group: two Black women and one Latina. The focus group took place on December 19, 2024, on the UMB campus.

TABLE I. GENDER AND ETHNICITY OF FOCUS GROUP PARTICIPANTS

Participant	Self-identified Gender	Self-identified Ethnicity	Classification
1	Female	Black	Junior
2	Female	Black	Senior
3	Female	Latina	Freshman

Recruitment of target populations was initially successful but ultimately limited. The focus group modality was initially planned to be exclusively in person, but some initial participants indicated scheduling conflicts and subsequently we added a video conferencing (Zoom) option, resulting in a hybrid format. Still, mirroring the very problem we sought to ameliorate, our research participation suffered from an attrition rate of approximately 57 percent: there were seven survey respondents and three focus group participants. Some planned participants shared reasons for their last-minute absence from the focus group, including lack of transportation and lack of access to a dependable internet connection, rendering it impossible for them to participate in person or via Zoom. Others did not respond to confirmations or checks after they participated in the survey despite attempts to communicate via multiple platforms. Still, those who did attend the focus group offered valuable insights that the department can use to improve broad participation in computing for historically marginalized groups.

III. SURVEY RESULTS

Please see APPENDIX A for full survey results.

IV. FOCUS GROUP RESULTS

Salient statements made by participants in the 107-minute discussion were codified into topics. While the themes are recursive and not mutually exclusive, the participants decided that they merited individual classification. As a result, five individual themes were documented; those themes were further coded into the two categories "experiences" (stories about what the women had seen, felt, heard, and done) and "suggestions" (proposals for solutions informed by these experiences).

TABLE II. FOCUS GROUP CATEGORIES AND THEMES

Thematic Category	Thematic Code
Experiences	Resistance to BIWOC students
	"Background" mental labor
	Survival vs. Change
Suggestions	Need for counter-spaces to share experiences
	Potential benefits of a BIWOC research hub

A. *Experiences*

1) *Theme 1: Resistance to BIWOC students*

Experiences related in Theme 1 included situations in which others established resistance to the BIWOC students' choice to study computer science, questioning the women's capabilities and implicitly or overtly sexualizing their presence in academic settings. The women classified the majority of these experiences as microaggressions [18], which are defined as subtle and often unintentional discriminatory behaviors, are particularly common in STEM fields and reflect underlying biases trough exclusionary practices that tend to behaviorally manifest our implicitly held stereotypes via sexist comments or unwelcomed actions [19]. Research indicates that microaggressions contribute to negative psychological and professional outcomes for BIWOC students when encountered without ally intervention, reinforcing feelings of isolation and eroding academic confidence or leadership outcomes [20], [21].

Participants highlighted societal and individual resistance to their presence in the CS field. Even the statistics indicating the gender imbalance in the field, often cited with the goal of broadening participation in computing, they noted, could be used intentionally or unintentionally to discourage them instead of support them:

> Participant 2 (Black, Senior): I feel like sometimes these statistics are pushed on you on purpose to kind of discourage you. I feel sometimes it's done in a way that makes you feel bad. Because I remember one time, I went to one of those internship fairs that the school has. I was with my friend and she's in nursing. And to her some company representative was like, "oh, yeah, like we have lots of healthcare positions for you." And to me he said, "oh, what's your major?" I told him I was doing CS. He was like, "Oh. Yeah. You're gonna have a lot of competition. There's a lot of men there. Does that worry you?" But he didn't say that to her. And she was Black too! Like yeah, okay, I know what the numbers look like.

Indeed, resistance to the women occupying space in the CS field often took the form of others questioning their choice. These doubters seemed for the most part to be men, and they occupied various roles, including not only potential employers like the one Participant 2 described but also those in non-academic positions:

> Participant 3 (Latina, Freshman): The other day I was in an Uber and I started talking to the [driver] guy, and he was telling me about how his son wanted to study computer science. We were talking about how that's a great field. Then he told me "you should marry one of those computer science guys." And I was like, I'm actually studying computer science. He was like, "Really??? And how? How are you doing? And why are you studying it?"... Sometimes yeah, like Participant #2 said, in the back of your head you're thinking about what other people may think, or how they might stereotype you when you apply for work.

The women were also concerned about the sexualization of their presence in academic settings, arguably another form of microaggression (and source of additional mental labor, to be discussed in the next theme). Participant 3 related a story of sitting in a math class with male students when the female classmate she usually sat next to was absent. When students dispersed after class, one of the male students in the group asked for her number. When she started speaking with him, another male student approached:

> The other guy came and he made a comment, like 'If you are so smart, you have to help all of us study anatomy' or something like that. I was like, this is crazy, there's no way

> you're saying this right now. And literally after that day, none of them have talked to me. None of them. But it's like, why are you making those comments to me? I felt so uncomfortable.

While Participant 3 considered the first male student to be harmless, other male students appeared to take her willingness to speak with him as an invitation for sexualization and innuendo. The result was that rather than making academic connections or networking with like-minded classmates, Participant 3 was hit on, then ignored. This dichotomy of women considered as either sexual targets or not worthy of attention at all, of course, is a classic tenet of misogyny. As De Beauvoir wrote, "Humanity is male, and man defines woman not in herself but as relative to him; she is not regarded as an autonomous being" [22]. Of course, this false dichotomy leaves no room for women to contribute in academic or professional settings. It seems, unfortunately, that this age-old objectification has made its way into STEM classrooms in 2024. While no participants shared experiences of misogyny or sexualization by faculty members, the presence of those phenomena persist in the classroom and add to the mental load that women bear in their efforts to study. This mental labor was so pervasive that it emerged as a separate theme in the focus group.

2) Theme 2: "Background" mental labor in responding to or actively ignoring the resistance identified in Theme 1.

Participants were unanimous in their reports that they found themselves performing extra "background" mental labor in responding to, or actively ignoring, the many forms of resistance they face as identified in Theme 1. Arguably, such labor has been required of women for millenia, and certainly has been researched for decades [23], [24]. Specifically in academic settings, it has been concluded that "People of color experience an unequal distribution of emotional labor as a result of negotiating both everyday racial microaggressions and dismissive dominant ideologies…" [25]. When those people of color are women, the labor and its effects are compounded: "The racialized and gendered nature of [Black women's] experiences gives further nuance to how race, gender, and the intersection of the two affect the invisible labor of minority academics" [26]. While there is a lack of research about emotional labor specifically as it applies to BIWOC students in CS programs, one could logically assume that the phenomenon is not improved by the low rates of enrollment and high rates of attrition of fellow BIWOC students. Our focus group confirmed this assumption:

> Participant 1 (Black, Junior): I feel like I'm gonna have to, like, constantly watch what I'm doing or how I'm doing it in order to try to maneuver in a professional setting. Which is a worry of mine.

Watching, maneuvering, worrying: extra effort, extra work on top of academic loads. There's little wonder that family members who want the best for their daughters may discourage them from going into CS, simply because of the discouragement that already exists in those academic and professional spaces:

> Participant 2 (Black, Senior): Sometimes I do have [the low number of enrollments of BIWOC students in CS] in the back of my head because, even with some family members… When I was applying, they were like, oh, like you should go into healthcare. You should do nursing.

As mentioned above, such discouragement in reference to the disproportionately low numbers of female computer scientists can come from a place of genuine concern for BIWOC students' wellbeing. But it can also take the form of gatekeeping, whether intentional or not. Participant 2 continued:

> But then I feel like sometimes it's overly pushed… like they're trying to do it to discourage you. It's like, yeah, I know what the numbers look like but I do see people who look like me that are in these fields, so it's not impossible.

Participants voiced their understanding of racial discrimination in professional settings as shared with them by family members. They were cognizant of racial tropes, and wary of expressing themselves so as not to trigger them. In our conversation, the identification of these racist and misogynistic stereotypes was immediately followed by resignation.

> Participant 1 (Black, Junior): I'm Black woman, and my family has told me things like, "If you take a certain tone you may be perceived as an angry Black woman." You're dismissed because you're in a small percentage of whatever workforce or group you're in, so like, it doesn't really matter if you're offended, or if you feel some type of way, because that's not gonna stop anything going on around you.

Again, the intersectionality of race and gender compounded individual issues of misogyny and racism. Again, the relation of such stories culminated in resignation. The same participant continued:

> It's more so the woman thing that comes up first. Then they'll find out my race, and then there's like a fetishization about it and they'll, like, keep bringing up the fact of my race when talking to me. So it's just like all these weird things combined into one and it's like, ok, that's how it is. But how can I use that to make my life a little bit easier? And get certain knowledge, or get where I wanna be. I can change the way I interact with them to make my life easier.

This changing of behavior is clearly a (successful) survival mechanism, a way of coping with racism and misogyny. Arguably, it is the inevitable response to discrimination. But its inevitability does not negate the fact that it is extra unpaid labor for students who already take on full academic loads in addition to part time jobs. How much further could these students advance were it not for this extra mental labor? In families of color, this extra work is begrudgingly acknowledged, and their children are on guard for it. The same participant went on:

> My family knows a lot about being black in the workforce and they're trying to make me understand. They say, "You have to be twice as good as them to get half of what they have." It's a lot of conversation that encapsulates that idea. You're already told from high school or whatever, like you have to be this much better in order to get where you want to be in the world, and in order to beat whatever systems have kept your family in the place that they are. And you observe all that at the same time. It really is like an ongoing battle, but it's like you have to work the system, don't let it work you… stuff like that. And I think that's where a lot of my thoughts come from when I interact with the world.

Little reflection is required to conclude that academic pursuits and life in general should not be "an ongoing battle" for those who are already marginalized. Indeed, previous research has established the many ways in which students of color in university settings experience racial trauma resulting in physiological effects that are not unlike those suffered by soldiers during and after literal battle. Smith coined a succinct phrase for the issue: "racial battle fatigue," [27] defined as "the physiological, psychological, and behavioral strain exacted on racially marginalized and stigmatized groups and the amount of energy they expend coping with and fighting against racism." Researchers building on Smith's theory have established that "people of color and their white allies who endure [historically racist higher education environments] experience a level of mental and physical anxiety that like diabetes, hypertension, and other chronic health conditions if untreated can be personally and professionally fatal" [28]. Participant 1's choice of words, prior to reading Smith's seminal work, reflect the accuracy of Smith's discovery and the unfortunate enduring nature of the phenomenon.

Participants acknowledged that they were not being officially assigned different academic work based on their gender or skin tone. They clearly delineated the form their extra mental labor took, all the more insidious for its implicitness:

> Participant 2 (Black, Senior): Right. And I feel for me personally, the whole thing about working harder, at least like I don't necessarily take it as you have to actually, like, do more work. It's more of a mental thing, but I have to work harder because [non-BIWOC students] don't have that in the back of their head… all these constraints, those statistics, this and that. For me, that's where the extra work comes from. Just that mental exhaustion and having to work through it on top of doing the actual work. It's not like doing the work itself. It's just that mental blockage.

3) Theme 3: Survival vs. Change: Navigating the world as it is versus trying to change it for the better.

The women indicated that they were caught between making things work as is and insisting on change. They found themselves resigned to join a professional world that quietly allows pervasive discrimination.

> Participant 1 (Black, Junior): Unfortunately for me, it's just like that's how it is, because like you go through that as a woman in, like, multiple aspects of your life. In my past jobs, I've had experiences with older men that were inappropriate. I told them to stop, told them you're making comments that make me uncomfortable. But then you have to show politeness or cordialness with them and then they think like, oh, it's OK for me to do XY and Z. And it's like, why do I have to keep telling you, and telling you, and telling you to stop? You have enough sense to know, that's not OK, but society finds a way to reinforce their behavior because nothing really bad happens to them. They think there's no consequences. It just kind of gets pushed to the side or people are like, oh, you might just be interpreting it that way or you're just being sensitive or stuff like that. So it's like for me, I already have to deal with it in other aspects of my life. I don't think I'll be alive to see much of a change in that, but hopefully we are pushing towards change. I don't think it's fair to say we should stop and like, let it be what it is, but in my experience right now in my lifetime, I think that's what it is and I can just try my best to, like push against it.

While Umass Boston was thankfully not a source of this particular discrimination, the women were quick to point out that the university diverges from "reality" in that way: "I feel I don't have to do as much of that here [at UMB], which is a good thing. But that's still not what reality is" (Participant 1, Black, Senior).

The concept of the "reality" of discrimination as something unmoving and ultimately insurmountable was further developed in the conversation. Participants acknowledged that they should speak up for themselves. But such speaking up, besides adding to the mental labor and extra effort already described, can also result in unwanted attention or punishment. As a result, some of the women admitted that they felt the need to make themselves smaller instead of insisting on fair treatment. This response was particularly gendered:

> Participant 3 (Latina, Freshman): Well, my whole family is Latino. My dad has always had this perception of: if something bothers you, just act on it. And sometimes, yeah, I think I have in the back of my mind that when something bothers me I need to speak louder, say something. But then when it's actually reality? It's like maybe for him, it's easier to say it to me because he can do that. Like he can pass as a white man basically, and does whatever he wants, but not my mom for example. And my mom always tells me yes, OK, maybe it's important for you to speak out and say things, but also for you, it's not going to have the same consequences as it would for him. So you have to sometimes measure yourself or retract something that you would speak about because of that same fear. You're not gonna be treated equally. So yes, like sometimes I think instead of actually reaching out or doing something about it, we just retract ourselves because of fear of something bad.

All participants were cognizant of the looming need to support themselves. All participants agreed that they chose the CS major in part for financial reasons: For example, Participant 3 initially wanted to study architecture, but she noted that the "startup costs" for students in that major were prohibitive. Participant 1 noted that she wanted to study psychology, but that her family encouraged her to specialize in a more lucrative field. The overlap between themes 2 and 3 were apparent in the articulation of her reasoning; the survival component of her struggle is clear, and she also pointed out that white and male classmates were not as limited by those concerns as she was:

> Participant 1 (Black, Junior): I don't think it's necessarily like assignment by assignment or class by class, but... I just feel like I don't have as much room to fail, and that's not even specifically targeted towards male counterparts, but just as like the bigger overarching issue in our society. Like I don't have money to fall back on. If this fails… that's kind of why I'm even in this field because.. my parents, neither of them went to college. They don't have money. I chose this out of survival. What I wanted to do, which is still interesting to me, is psychology. But that doesn't pay as well as certain types of jobs, so it was, "You need to get a degree you can actually use." Because we don't have that kind of cushion that other people have. That… I don't wanna say white people as a whole, but… that most white people have. Of historically just being able to do XY and Z, or having some sort of cushion financially. It's just like: I don't have that. So you do have to work twice as hard to get, you know, a fraction of that stability.

Prior research indicates that the women are not alone in their implementation of coping mechanisms as they contend with microaggressions and discrimination in multiple facets of their lives. Previous studies have shown "that coping mechanisms employed by African American and Mexican American students can mediate the impact of racial microaggressions on racial battle fatigue related stressors" [9]. Of course, such a stopgap measure is far from sufficient, and imposes negative "biological, psychological, and social" effects on the people who resort to them [29].

B. Suggestions

The women were quick to identify potential solutions to these problems.

4) Theme 4: Need for counter-spaces to share experiences of microaggressions, seeking encouragement and support.

One participant noted that she found helpful community connections and mentorship for women of color via a program in the city of Boston called G(Code). She mentioned that she participates in that community online, and it would be helpful to have in-person connections to a similar organization at UMB. G(Code) is comprised of "city planners, technologists, and activists working towards equity and social justice by providing young women and non-binary people of color with foundational needs such as housing, inclusive communities, quality education, and expanded access to economic opportunity" [30]. Given the organization's proximity to Boston, a collaboration with them may be practical.

Participants articulated a need for BIWOC-focused spaces that could provide comfort, guidance, and resume-building opportunities for students like themselves.

> Participant 2 (Black, Senior): I don't see a lot of other black women in my classes now. There was an IT club get-together. I went to that, and there were no [BIWOC students] there. It was all like people of other demographics, and then mostly men. So even though I know there are other people within my demographic, I do not see them. So I don't even have the chance to really connect with them before I graduate, which is kind of discouraging, especially if you feel like you already don't belong in the field. I don't see a lot of other people that look like me in the field either. So it's almost compounded the initial discomfort.

Still, the women were hesitant to silo themselves in a club that was only for BIWOC students. They did not want to create spaces that would substantially differ from the professional domains they hoped ultimately to occupy. A club that was "just" for BIWOC students was deemed too insulative from people of other races and genders, but the lack of a space for BIWOC students was clearly problematic.

> Participant 1 (Black, Junior): My first reaction would probably be a BIWOC club specifically for CS majors, but then that's kind of isolating you from who you're gonna be dealing with career wise. But having a space where you're around other people like you… I wish I saw more programs promoted where certain requirements don't have to be met, like you don't already have to have this or that GPA or this number of classes under your belt. If you wanna join, join in and just go from there. I think that would be really encouraging and it would help more people feel supported in this field.

> Participant 3 (Latina, Freshman): Because, for example, there is a computer science club that is women in CS. And if you go to the meetings, you feel supported because they are all women. But despite that, you still feel… the date that I went, there were no BIWOC students there. Just white [women] and Asian [women]. So yeah, you feel supported because they're all women, but I'm still missing my people here.

Eventually the women concluded that the non-exclusionary nature of the club was of paramount importance. They were very cognizant of the fact that the professional spaces they aimed to occupy would not have homogenous comfort zones carved out for them, and they didn't want to establish such strictly defined gatherings for themselves here at the university level. Instead, they emphasized their desire to create a space for BIWOC students that would prioritize their agenda while still including people from other demographic backgrounds. In this way, they could bridge an existing gap without siloing themselves behind a demographic wall.

Soon a viable solution began to take shape. The women identified the need for a communal space in which they could have concrete academic benefits that emphasized BIWOC inclusion, but not to the point of excluding students from other backgrounds.

5) Theme 5: Creation of a BIWOC-focused research hub

The women concluded that a new organization should serve multiple purposes. They wanted an organization that would not only provide a space for community building but also provide tangible benefits. They specifically mentioned the need for activities that would build confidence in navigating university processes, and the need to orchestrate workshops and research that would help them build their resumes.

First, the collaborative nature of the club was emphasized:

> Participant 3 (Latina, Freshman): I think it would definitely be worth it. Like a BIWOC club, but lots of collaboration with other established groups.

Another goal of the new organization was identified as increasing comfort and social capital of students who are the first in their families to attend college, especially when it comes to navigating the academic-adjacent world of choosing tracks within majors, accessing university resources, and knowing where certain offices are. Such programs do exist at Umass Boston, but were deemed as premature, insufficiently publicized, or sometimes just insufficient:

> Participant 1 (Black, Junior) I did try to use ACES (the Academic & Career Engagement & Success Center) and the Student Success Center but it was kind of a wild goose chase for information. When I was in that office, they always just kind of sent me around everywhere. So I just kind of stopped going there and that's just another level of discouragement because it's like, you came here for help. It's just annoying, so you don't keep pursuing it.

Participants in the discussion of attrition among BIWOC students in computer science agreed that the day-long, beginning-of-the-year freshman orientation sessions are insufficient to familiarize BIWOC students with the department. Compounding the issue is the fact that many students who eventually join the CS department do not know which major they will choose when these orientation sessions take place. Some students, including BIWOC students, join the computer

science department months or even years after these sessions have ended.

The current programs aimed at integrating new students into the department, such as orientations and the Student Success Center, are most actively advertised to freshmen. As a result, their activities are precipitous for students who do not stick with the major they initially declare. Students, and especially BIWOC students, who join the computer science major after their freshman year lack those opportunities to cultivate community or develop social capital to navigate the department effectively. For instance, UMB offers semester-long "freshman success gateway seminars" for new freshmen joining the computer science major. These seminars have received positive reviews in the past for helping students feel comfortable in the department through activities like learning how to address and contact faculty members, understanding the differences between various tracks offered, and completing scavenger hunts to identify campus resources. However, students who join the major after their freshman year do not have access to comparable resources tailored to their needs.

> Participant 1: During orientation, it's already separated by what you chose for your major… I had started out with psychology, and I just chose CS in my last two years of school. So now I'm having to navigate all by myself without having those first two years of foundational knowledge. At orientation you're like, 18 years old, just coming out of high school. How would I know about how things work in the CS department?

To address this gap, the women suggested that the BIWOC Research Hub could establish workshops each semester for newcomers to the major. These workshops would provide the knowledge and support typically offered during freshman-focused sessions. This solution would be particularly beneficial for BIWOC students and first-generation college students, helping them develop the social capital necessary to feel comfortable and advocate for themselves within the department.

The new organization would therefore be BIWOC-focused (but not exclusive) and accepting of students of all ages needing orientation to the department and university. It could serve as a safe space in which members could share experiences and blow off steam that gathered both from discriminatory microaggressions and from life in general. Additionally, the women wanted the club to serve not only as a source of information and community but also be a launching pad for resume-building experiences. The idea of a "BIWOC Research Hub" was floated. The women were very receptive and began helping to mold its purpose:

> Participant 3 (Latina, Freshman): Now I see we all have had these microaggressions, like so many experiences that we haven't talked about to anyone. And I think getting them off your chest is necessary and makes you feel better. And saying like, hey, I'm not alone in this. This happens, but I will have a space to let them out and not have them inside of me, affecting me constantly. Maybe if this BIWOC research hub comes together, there could be workshops on microaggressions where people kind of share those instead of letting them build up.

The women were unanimous in their desire for the club to provide a space for processing racial stress, but were also firm in their desire for the organization to help them advance their academic and professional goals.

> Participant 2 (Black, Senior): I agree with just having space to like, talk about what you have experienced. Sometimes I feel there's a worry [that] things might be taken the wrong way. Or we even gaslight ourselves into accepting it. It's nice to just have that community. But I want to get something out of it. I think that does play a role in why people don't participate. If I wanted a gathering, I could just go to, you know, the art club or something like that. I think it would help a lot if it was… you're there for community, but you're also there for success.

A final consideration for the BIWOC Research Hub was publicity. There is a Women in CS (WiCS) club at UMB, but there is very little publicity about it, which results in a lack of awareness of it by students who would certainly benefit from such an organization. Of the seven survey respondents, five were aware that there is a WiCS club at UMB. When asked about their experience with the club, two of those five respondents selected "I'd be interested to join but don't know much about it." The remaining three were members of the club but selected "I joined but haven't interacted with it much since then." None of the respondents were active in the club despite their interest in sharing a community space, indicating an opportunity for improvement:

> Participant 3 (Latina, Freshman): I didn't even know about the women in computer science club until, like, a month ago. It was only because someone who was in it told me about it. If I didn't know her, I wouldn't know about the club.

> Participant 2 (Black, Junior) People don't join. It's not advertised much. I feel like some other things get pushed more: the IT club for example. I've heard of that. But the women in computer science club? I didn't know about that.

Rather than suggesting changes for that established group[2], the creation of a new group that would implement the specific BIWOC goals was considered to be appropriate. Participants were optimistic that the BIWOC Research Hub could collaborate with other campus groups such as the WiCS club and the nascent UMB chapter of the National Society of Black Engineers, while creating leadership and community-building opportunities for themselves.

The creation of a BIWOC Research Hub for UMB is supported by previous studies that aimed to address attrition rates of historically underrepresented STEM students. In addressing the risks of attrition in STEM classes, a conceptual model was developed that identifies factors influencing persistence in STEM majors at four-year undergraduate institutions using a hierarchical generalized linear modeling (HGLM) [31]. The model serves to evaluate predictors affecting women's persistence in STEM majors, considering variations across institutional contexts, such as Historically Black Colleges and Universities (HBCUs) versus predominantly White institutions. The model links the college entry phase, which accounts for students'

[2] The WiCS is run by students. One of the PIs has reached out extensively to the WiCS group, trying to push their announcements to the department's web page and other forms of public media, but didn't receive a response for over a year.

backgrounds and previous experiences, to influences including parental socialization, college experiences, and institutional norms and values. These interconnected themes were incorporated into the survey and focus group discussion, providing a comprehensive framework for assessing persistence. Between the research aspects, it was found that in support of the performance aspect of another model [32], women of color who participated in research programs are nearly twelve percentage points (Δ-P = 11.61*) more likely to persist in STEM fields.

V. Discussion[3]

While this study did yield valuable information about BIWOC student experiences, its validity was impaired by multiple limitations. These limitations, combined with the previously discussed limitations of the focus group research method, render the conclusions of the research neither prescriptive nor generalizable for those inside or outside of our department, beyond the suggestions of the BIWOC participants.

A. Limitations

1) Focus Group Size

The weak focus group participation rate resulted in varying degrees of limitations in the study. Extrapolating from collected demographic data, there are 97 BIWOC undergraduate students in our department. Only three students out of the eligible 97 participated in the focus group, hindering the possibility of group subdivisions by gender, ethnicity, and classification (freshman, sophomore, junior, senior). Given the extremely low participation rate, all participant responses were combined in a single study.

2) Lack of Subdivided Data Labels at the University and Department Levels

The demographic data cited in the introduction of this paper were derived from the university's Office of Institutional Research, Assessment, and Planning [33]. That office replicates the United States Census Bureau's definition of someone of Asian ethnicity as "a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam" [34]. The panethnic nature of this label has tricky consequences for the definition and connotation of "Students of Color" both in the current research and in general racial inquiry [35]. Extrapolating from (albeit limited) responses to the survey, it is clear that Southeast Asian students in our department identify as students of color. Given the lack of subcategorization of the "Asian" label, however, it is not possible to conclude if Southeast Asians are underrepresented in our department; all we know is that "Asians" as a group currently outnumber white students and were therefore not considered to be underrepresented for this research project. The underrepresentation of this group can, however, be theorized upon reviewing the sheer number of populations grouped under its label (more than 20 ethnicities [36]) and data from other sources that do include subcategories for Asian ethnicity labels [37]. Comparing Asian subgroups' "justification" for inclusion in the label "people of color" results in ambiguity fraught with colorism and institutionalized racism [38], which is beyond the purview of the current research. Including Southeast Asians as SoC in this research may be valuable in that it aligns with those students' self-identification and, most likely, they are members of populations that are historically underrepresented in our department. However, such inclusion may also be considered problematic in that, regardless of researchers' intent to the contrary, it may result in the interpretation of their experiences being representative of all minoritized groups, including Black, Indigenous, and people of color (BIPOC) populations. At minimum, this lack of nuance in ethnicity labels at our university should be addressed, especially before future projects are conducted that hinge on ethnicity-oriented inquiry. The necessity of such subgroups for Asian populations has also been noted in other research [39].

B. Researcher Positionality Statement

Women and people of color are historically underrepresented not only in student enrollment of Computer Science programs, but also among full-time Computer Science faculty [40]. At the CS department at UMB, there are currently no female faculty of color. Out of 25 total faculty members, there are two female adjunct instructors and three female tenure-track professors, four of whom identify as white and one who identifies as Asian. There is one Black tenure-track instructor and there are two Black adjunct instructors; they are all male. The current research project was organized by a white female adjunct instructor and a white male tenure-track professor. Only one Black instructor currently engages in computer science research at our university. As mentioned in our BPC plan, our department is sorely in need of faculty of color, especially women of color, and especially Black women. While the participatory nature of this project elevated participants to the level of researcher and they were active in the creation and organization of the study, White researchers questioning and documenting the experience of students of color in a domain in which those individuals had historically been marginalized is certainly a suboptimal arrangement. This study is considered to be a starting point in improving representation and identification of relevant issues in our department. Still, researchers' whiteness in this context arguably resulted in "unwittingly exclusionary" [41] inquiry at best, and "methodological whiteness" [42] at worst.

C. Suggestions

Based on the substantial amounts of targeted input from our focus group participants of color and female students, we put forth the following suggestions for the department:

1. Create a non-exclusionary BIWOC research hub for undergraduate students, which will serve not only as a vector for increased research opportunities but also a place for decompression and community for BIWOC students.
2. Implement extensive measures to establish visibility for the club via posters, T-shirts, etc.
3. Collaborate with G(Code) to strengthen ties between BIWOC students at UMass Boston and a group that has historically helped BIWOC students.

The CS department at UMB is proud to recruit, educate, and graduate students of color at one of the highest rates in the nation. While we celebrate our success with students of color, there is more work to do. The focus group conducted for this research elucidated both subtle and conspicuous avenues for improvement of student experiences and outcomes within our department, especially for those who identify as women and students of color. University and departmental criteria for distinctions between ethnicity labels require more nuance. The creation of a BIWOC research hub and strengthened connections to extant community mentoring groups for women of color in STEM are the areas of interest for female students of color in our department.

VI. Appendix

Survey Results

Question	Answers
Classroom Experience, *Cronbach's alpha a = 0.51*	

[3] This section is drawn in part from ethnographic phenomenological research the authors previously conducted.

How would you classify your overall experience as a student in the CS department at UMB so far?	Average: 6, Poor: 1
How supported do you feel by faculty in your CS classes at UMB?	Supported: 3, Neutral: 3, Not supported: 1
How comfortable do you feel participating in class discussions and group projects in your CS classes?	Extremely comfortable: 1, Neither comfortable nor uncomfortable: 4, Somewhat uncomfortable: 1, Extremely uncomfortable: 1
Perceived Representation, *Cronbach's alpha a = 0.82*	
How well do you feel BIWOC (Black, Indigenous, Women of Color) students are represented in the computer science curriculum at UMB?	Moderately well: 5, Slightly well: 1, Not well at all: 1
How well do you feel BIWOC students are represented in the student demographics of your class?	Moderately well: 1, Slightly well: 5, Not well at all: 1
Sense of Belonging and Comfort, *Cronbach's alpha a = 0.86*	
Please indicate your level of agreement with the following statement: "I feel like I belong in this department."	Strongly agree: 1, Somewhat agree: 2, Somewhat disagree: 4
To what extent do you agree or disagree with the following statement? I feel comfortable being myself in this department.	Strongly agree: 3, Somewhat disagree: 4
To what extent do you agree or disagree with the following statement? I feel valued by this department.	Somewhat agree: 4, Somewhat disagree: 3
To what extent do you agree or disagree with the following statement? I feel like part of the community in this department.	Somewhat agree: 3, Somewhat disagree: 2, Strongly disagree: 2
Microaggressions, Discouragement and Encouragement	
Have you ever experienced any microaggressions (subtle, indirect, or unintentional discrimination) in the classroom based on your identity? Please explain if you'd like to.	Yes: 2, Maybe: 3, No: 2 "From male students specifically in a more condensing way"
Are there any instances where you felt encouraged because of something a Computer Science (CS) professor, faculty member, or student at UMB said or did? Further explanation is optional.	Yes, a faculty member encouraged me: 2,Yes, a student encouraged me: 4, No: 1 "Extracurricular projects that involve faculty member support and team development, encourage students to stay in the field (as the hackathon)" "They just gave me hope and didn't make me feel dumb" "Several classmates see me as a mentor and feel like they belong because I do my best to support them. Taking my pre-reps at community college, exposed me to the current coursework, giving me an upper edge compared to other students who are learning the programming language for the first time"
Are there any instances where you felt discouraged because of something a Computer Science (CS) professor, faculty member, or student at UMB said or did? Further explanation is optional.	Yes, a faculty member discouraged me: 4, Yes, a student discouraged me: 1, No: 2 "My CS110 Professor is always discouraging us, like he almost want us to fail his class." "I've been told by that 'I should already known this' before." "Just the way they spoke to me it was as though they were talking down on me"
Women in Computer Science Club	
To your knowledge, is there a club for Women in Computer Science at Umass Boston?	Yes: 5, No: 2
What is your experience with that club?	I joined it but haven't interacted with it much since then: 3, I'd be interested to join but I don't know much about it: 2

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