ACTUALIZING GENDER AND RACIAL DIVERSITY INCLUSION IN COMPUTING FIELDS

by

ELIZABETH RUSHING WILLIAMS

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Actualizing gender and racial diversity inclusion in computing fields

Elizabeth Williams, *Middle Georgia State University, elizabeth.williams7@mga.edu*

Abstract

As the computing industry vocalizes the prioritization of diverse experiences, minimal improvements have been made to provide an equitable and representative work experience for diverse professionals. With women representing less than 28% of the STEM workforce and racially-diverse professionals representing less than 37% of STEM professions, both gender and racially-diverse candidates represent a minority within the industry (Fry et al., 2021). This contrast in representation is exacerbated by diverse professionals leaving the field at a disproportionate rate compared to their Caucasian male colleagues (Fry et al., 2021). This research was conducted to report findings surrounding the motivation behind diverse professionals' decision to exit the computing industry alongside recommendations for improvements to workplace inclusivity. These conclusions were identified through the analysis of two research questions: 1) Why do underrepresented, diverse professionals exit the Computing field? and 2) What improvements can organizational leadership implement to retain and grow diverse employees? Through a survey facilitated by SurveyMonkey Audience and link sharing through LinkedIn and local universities, 330 participants provided their insight to questions regarding work experience and opportunities for improvement. Utilizing NVivo 20, grounded theory qualitative analysis was conducted to find commonalities in contributor responses which formed a basis of participant voices through three selective codes: 1) Compensation Equity, 2) Representation, and 3) Inclusive Work Environment. These cohesions provide a foundation upon which organizational leadership can increase equity and representation while implementing survey feedback for retention improvements within their organization. Future opportunities for research should include a larger sample size with diverse geographic representation, considerations for ethnic diversity, and challenges faced by LGBTQ+ professionals within the industry.

Keywords: computing, diversity, inclusion, race, gender, equity, retention

Introduction

Women represent less than 28% of the science, technology, engineering, and mathematics (STEM) profession (American Association of University Women [AAUW], 2020). Racially-diverse representatives make up less than 37% of STEM professions (Fry et al., 2021). Both gender and racially-diverse professionals exit STEM fields at a disproportionate rate compared to their Caucasian male counterparts (Fry et al., 2021).

As diverse professionals leave the field, little research has been conducted to identify the rationale for their exit to inform methods of retention for organizations. With an increasing focus on diversity and inclusion within our field, it often seems as if companies are "talking the talk" but not fulfilling their promises with action. This research will focus on why diverse employees have considered leaving or have left their respective STEM fields with garnered feedback utilized to provide leadership strategies for an improved work experience for diverse professionals. This research will answer the following questions:

RQ1. Why do underrepresented, diverse professionals exit the Computing field?

RQ2. What improvements can organizational leadership implement to retain and grow diverse employees?

The findings of this study will inform challenges faced by diverse professionals alongside their rationale for leaving or the consideration of leaving the field. While organizations have been vocal regarding diversity initiatives, existing diversity programs are unsuccessful (Hurtado et al., 2010). Initiatives such as mandatory diversity training, focus on the number of diverse hires, and grievance systems are often unsupported by leadership and organizational culture and are unmeasured for internal success (Hurtado et al., 2010). Through this research, we will identify the root causes of diversity challenges alongside opportunities for improvement that can be implemented within organizations. The implementation of these enhancements will increase diversity hiring, maintain employee retention, and build an environment that fosters the growth of diverse professionals.

Literature Review

Brown et al. (2022) interpreted the lived experiences of Native American (NA) STEM faculty members at research universities and medical schools. Participants highlighted a need for tribal research, mentoring, faculty-student relationships, and self-expression through their own unique experiences, culture, and teachings. Native American participants also highlighted barriers to success for their communities including 1) Institutional and Administrative Policies which created challenges for positive change to be made within their respective universities, 2) Cultural taxation – or the idea that being a diverse individual meant required participation on diversity boards and search communities which were considered an honor and a cause for burn-out by participants, and 3) Oral Presentation vs. Written Publication – given the Indigenous tradition of storytelling, Native American faculty forced into written publication identified the lost art of in-person, storytelling communication. Native American faculty reiterated the significance of oral communication infusing STEM topics with traditional storytelling for impactful knowledge transfer. Conclusions from this research underscore the importance of career advancement, professional development, and mentoring programs to further support Native American faculty in STEM achievements (Brown et al., 2022).

Castagnetti et al. (2020) reviewed the disappearance of gender pay gaps among public-contest-selected employees in Italy and how blind reviews can make an impact on diverse recruitment and pay. Given the known gender pay gap between men and women in both the United States and Europe, Italy established within Article 97 of the Italian Constitution a public recruitment and review requirement for public employees. The process combines tests and investigation of qualifications submitted in writing with blind review by a selection board. Through this blind review process, Italy has been able to see improvements in gender pay gaps and diverse representation in public-sector roles. While this law serves as a framework for private-sector hiring, this method of public review for private entities is not addressed in Italian law (Castagnetti et al., 2020).

Dasgupta & Stout (2014) evaluated the scarcity of women in STEM fields by considering the basis of gender disparities in STEM and potential solutions. Their research found that three developmental periods: (a) childhood and adolescence, (b) emerging adulthood, and (c) young-to-middle adulthood presented different obstacles to STEM interest, achievement, and persistence. From childhood to adolescence, masculine stereotypes about STEM, parents' expectations of daughters, peer norms, and lack of fit with personal goals may influence girls away from an interest in STEM. In emerging adulthood, a lack of female role models, feeling like a misfit, and being outnumbered by male peers may prevent women from entering the field or cause them to leave prematurely. In early to mid-adulthood, gender bias in hiring and promotion, biased evaluation, tense departmental climates, and juggling work-family responsibilities may undermine the retention of women in STEM. For each of these obstacles, evidence-based programs can assist women interested in STEM fields to realize their goals. For young girls interested in STEM, STEM learning environments and school partnerships with museums and STEM departments at universities can assist in bridging this gap. For emerging adulthood STEM visionaries, opportunities for peer networking, role

models, and mentorship for women can help encourage female participants. For young-to-middle adulthood participants, blind application review, inclusive STEM department climates, work-life balance, and professional development opportunities can increase female participation in STEM roles (Dasgupta & Stout, 2014).

Grossman & Porch (2013) examined urban adolescent perceptions of gender and racial/ethnic barriers to STEM success by surveying a sample of 1024 high school-aged students with interviews from 53 students. Findings identified trends of microaggressions and having to respond to these hostile situations while finding comfort and support through teachers and family. As demonstrated in participants' responses, messages from teachers, counselors, and families about STEM engagement and achievement can help to counteract stereotypical gender and racial/ethnic expectations by encouraging their STEM pursuits, and helping them to identify microaggressions, rather than internalize negative messages about their group (Grossman & Porch, 2013).

Hurtado et al. (2010) evaluated national project initiatives for STEM success in racial minorities led by the National Institutes of Health (NIH) and the National Science Foundation (NSF). In this study, the UCLA Higher Education Research Institute (HERI) selected a targeted sample of over 44,000 college students majoring in STEM fields. Utilizing this data set, researchers looked to identify the conditions and practices within universities which increased retention in STEM and prepared students for graduate school and STEM-related careers. Students were followed for seven years during this study to compare first-year success rates to those that completed a bachelor's degree, pursued STEM-related jobs, and/or continued through additional STEM education. HERI researchers identified several contributors to STEM success which varied in perceived experiences from white, Asian American, and underrepresented minorities (URM). Related to transitioning to a university or STEM-related career, there were significant effects on URM majors related to racial climate, cross-racial interactions, financial concerns, and the relevance of their science coursework. Additionally, students reported facing "solo status" being one of the few racial minorities where peers make presumptions of under-preparedness despite their significant achievements (Hurtado et al., 2010). Initial findings suggest that individually tailoring departmental and organizational practices to each client's unique needs, context, and attributes can improve their potential for success (Hurtado et al., 2010).

Kanny et al. (2014) analyzed the gender gap progress over forty years of research in STEM disparities for female participants. In a review of 324 full texts spanning 40 years of scholarly literature, five themes emerged: individual background characteristics, structural barriers in K-12 education, psychological factors, values, and preferences, family influences and expectations, and perceptions of STEM fields. As the U.S. federal government has declared the fields of science, technology, engineering, and math "areas of national need", researchers found this field of focus imperative to identifying the cause for underrepresentation from half of the U.S. workforce. Where many assumptions have been made through forty years of available research, authors point out that only moderate progress has been made in increasing women's STEM participation relative to the research efforts on the topic (Kanny et al., 2014).

Kroeper et al. (2022) analyzed the recent surge in technology companies seeking diversification strategies to attract female workers. Gender nondiverse organizations looking to correct their lack of diversity can engage in "counterfeit diversity" or the act of misrepresenting their true levels of diverse talent to recruit diverse professionals. Research results revealed that both men and women perceive this misinformation as insincere with a potential for identity threat concerns among women hires. Identity threat is a set of psychological concerns about the value of one's identity in a setting, including worries about belonging and authenticity as well as concerns about being devalued, disrespected, stereotyped, and marginalized in a setting (Murphy & Taylor, 2012). Where gender underrepresentation is a common challenge for technology

organizations, sincerity in diverse efforts can often make a more lasting impact than attempts at counterfeit diversity (Kroeper et al., 2022).

Nakajima et al. (2022) discussed diversity inclusion in *"Why Isn't This Space More Inclusive": Marginalization of Racial Equity Work in Undergraduate Computing Departments* through conducting a qualitative analysis with 55 campus leaders at four U.S. higher education institutions to examine diversity initiatives and its impact on undergraduate Students of Color (SoC) success in CS majors. The findings indicated that racial equity work occurred primarily in three counter spaces – professional conferences, campus identity centers, and student organizations. While these efforts were recognized on campus as offering diverse community, professional and academic networks, and student identity affirmations, computing departments were largely segmented from these efforts. This division limits the migration of diverse ideologies from student centers to computing programs. In bridging these opportunities for equity and inclusion throughout campuses, a shared, welcoming learning environment could be shared for all (Nakajima et al., 2022).

Roberson et al. (2020) offered a learner-centric, process-based model of diversity training that considers learning concepts and the characteristics of the learner through pre-training, training, and post-training environments with self-regulatory structure. As training is uniformly designed for a broad range of employees and organizations, trainee readiness assessments that consider each participant's unique behavior is not taken into consideration. To accommodate for this, needs analysis can assist in identifying the knowledge, skills, and behaviors needed for employees' effective job performance and desired training objectives. Through this assessment, cognitive, motivational, and affective readiness can be examined for preparedness for the exercise. In the progression toward active training, self-regulatory accountability can be reinforced through diversity training content that engages learners in confronting, tempering, and modifying their emotions toward diversity topics that may provoke frustration and anxiety. Post-training success should identify cognitive, motivational, and affective transfer from diversity training for immediate implementation into the everyday work environment. Diversity training effectiveness should be measured to assess cognitive and motivational learning adaptations following successful training completion. To evaluate cognitive learning, knowledge tests can be utilized to assess diversity training effectiveness. To evaluate motivational learning adaptations following successful training completion, self-reflections – such as through organizational goals – should be evaluated to identify attitude change post-training. Utilizing a learner-centric method, diversity trainers can tailor training opportunities to organizational units and individual learners based on strengths and weaknesses identified within the organization (Roberson et al., 2020).

Yamaguchi & Burge (2019) investigated the narratives of 93 Black women in the computer science field to identify common themes surrounding race and gender. Utilizing a multi-method approach with participants completing a survey and participating in focus groups, grounded theory analysis was then utilized to review the intersectional experiences of participants. From this study, emerged four themes: 1) the importance of linking Black women in computing recruitment, retention, and career growth, 2) effective cultural and educational supports for Black women in computing across pathways, starting in middle school, 3) leadership development provided as a part of their educational and workplace experience, and 4) a collection of empirical research and scholarship about and for Black women as a part of computing literature. With themes of self-development and co-development, Black women will have the opportunity to form bonds alongside one another while providing pathways for greater inclusion of Black women in the computing field (Yamaguchi & Burge, 2019).

Methodology

This research stemmed from the results of a mixed-method survey with a sample of 330 participants (50.38% male, 49.62% female) completed for a grounded theory iterative data collection and analysis approach. Survey representation was intended for participants of all ages, with all levels of professional experience, and from both female and male participants of diverse representation. To reach the target audience, survey questioning included two "or" clause disqualification questions that would disqualify based on a "No" response provided to either question.

If both questions had "Yes" responses, participants were able to progress to the next round of questioning. Only 42% of the intended participants (330 of an attempted 779 participants) were able to complete the survey without disqualification.

Disqualification Questions:

1) Are you a current or former professional within the Computing field (Computer Science, Data Science, Cyber Security, Information Systems, Information Technology)?
2) Are you a gender or racially diverse representative within the Computing field?

Using an iterative collection approach, data collection consisted of three rounds: 1) SurveyMonkey Audience with a national audience, 2) survey link sharing via LinkedIn, and 3) survey link sharing across university systems within Middle & South Georgia, United States. The first round of collection via SurveyMonkey audience received 266 completed responses with industry targeting configured for the "Telecommunications, Technology, Internet & Electronics" industry. The final two rounds via LinkedIn and University link sharing received 62 completed responses for a total across all mediums of 330 completed participant responses.

The distributed survey consisted of both quantitative and qualitative questioning with the intent to gather insight into a diverse representative's consideration to leave the Computing field as a result of inequity or discrimination. Likewise, participants were asked to provide improvement suggestions for diverse recruitment and retention.

Grounded Theory

This research follows a grounded theory qualitative analysis methodology. "Grounded theory is an inductive methodology that attempts to bridge the gap between research and theory" (Glaser & Strauss, 1967).

Grounded theory has three established schools of thought with each having its definition of the data collection and analysis process and the level of involvement of the researcher. Classical Grounded Theory (GT) serves as the foundation for the grounded theory model and was developed in 1967 by Glaser & Strauss with a free-flowing methodology for data collection, interpretation, and analysis (Sebastian, 2019). In 1990, Strauss & Corbin expanded upon this framework coining Interpretive Grounded Theory (IGT) which provided a more structured approach to data collection with iterative phases and structured coding to validate theories with qualitative findings (Sebastian, 2019). Finally, Constructivist Grounded Theory (CGT) combines the previous theory practices but emphasizes the researcher's viewpoint. In this iteration of grounded theory, the researcher holds a prominent position serving not as a neutral observer, but as a co-participant in the survey (Sebastian, 2019).

For this study, Strauss & Corbin's Interpretive Grounded Theory (IGT) model was utilized for coding and theme mapping through open coding, axial coding, and selective coding stages. In following this model,

Glaser's theory of "epistemological assumptions, logic, and [a] systematic approach" alongside Strauss' "notions of human agency, emergent processes, social and subjective meanings, problem-solving practices, and the open-ended study of action to grounded theory" are recognized as principles for data collection and analysis (Charmaz, 2014).

Data Coding

The responses from 330 survey participants were imported into NVivo 20, a qualitative analysis software tool, for IGT open, axial, and selective coding. Manual data extraction was conducted to code participant responses into grouped themes that represented commonalities faced by participants.

Open Coding

The grounded theory builds upon a framework of exploratory identification of patterns within data and using these comparable findings to form new conclusions. Open coding refers to the initial review process where the researcher pulls concepts from gathered data which may assist in answering the identified research questions. For this study, the open coding process was conducted by manual review of all survey responses utilizing both descriptive and *in vivo* codes to identify related data points (Saldaña, 2016). *In vivo* coding emphasizes the exact phrasing of the participant pulling literal meaning from the data itself (Saldaña, 2016). By assigning initial codes with applied *in vivo* coding, researchers looking to recreate this study can compare previous participant sentiment to that of their study.

Axial Coding

Axial coding is the process of relating known data together to form codes, categories, and subcategories grounded in participants' voices (Allen & Simmons, 2017). This process requires the understanding and translation of participant responses allowing the researcher to put themselves in the participant's shoes in the review of feedback. Axial coding – as with the other stages of coding – must accurately represent participant feedback to produce a precise assessment of participant responses. The axial coding process for this research was conducted in NVivo 20 via a manual review of the initial codes and *in vivo* interpretations gathered from the open coding procedure. Similar concepts were then mapped together to identify commonalities within the data which represented uniformity of perception from participants. For example, the codes, "Equal Pay", "Benefits", and "Pathways to Promotion" can all be mapped to the axial code, "Compensation Equity".

Selective Coding

Selective coding builds upon the open and axial coding process by connecting existing categories into primary or "core" categories. These final categories serve as unified theories around your research topic and may also answer your intended research questions. The selective coding process for this research was conducted in NVivo 20 via a manual review of open and axial coding. The remaining themes from the axial coding stage are summed up in the selective coding process to represent three themes: compensation equity, representation, and an inclusive work environment.

Results

The results of this study stemmed from grounded theory qualitative analysis utilizing NVivo 20 for the identification of common participant experiences. With 330 participant responses via a SurveyMonkey survey targeting diverse industry professionals, the most prevalent themes from participants were compensation equity, representation, and an inclusive work environment. These results were found to be the overarching themes of all participants who shared their personal experiences and emotions related to

these characteristics. Through qualitative analysis and coding in reflection of an ongoing topic such as diversity, participants can have their voices and experiences heard while offering immediate suggestions for improvements to the challenges of diverse representation.

Table 1: Diversity in Computing – Grounded Theory Coding

Open Coding	**Axial Coding**	**Selective coding**
"Fair and equal pay" *"Offer more benefits and access to promotions."* *"Acknowledging experiences, equal pay and benefits…"*	Equal Pay Benefits Pathways to Promotion	Compensation Equity
Diverse recruitment *"More people like me"* Diverse leadership *"Provide leadership opportunities to diverse employees."* Celebrating Diverse Traditions Mentoring Transparency in the interview process *"Diversity in hiring panels."* *"Blind reviews"*	Diverse Recruitment Transparent Recruitment Diverse Leadership Mentoring	Representation
Diversity Training Diversity, Equity, and Inclusion (DEI) Programs Flexible Work Environment *"I have been assaulted twice, screamed at over my desk. I've been sexually harassed a few times. I had to complain repeatedly about my director hugging me and calling me terms of endearment that made me very uncomfortable. I just saw how upper management did not know how to handle these things when brought to their attention. Working remotely has helped not being put into these situations."* *"Safe Space"* *"Treat others as you want to be treated."* *"Compromising, listening"* *"Think before you speak."* Open collaboration and communication No-tolerance policy on bias	Diversity Training Flexible Work Environment Empathy (Fairness, Equality, Kindness) Open Collaboration and Communication	Inclusive Work Environment

Note: This table summarizes this research study's grounded theory coding findings. Survey participants of diverse gender and racial representation provided their personal career experiences and suggestions for field improvements to promote the recruitment and retention of diverse Computing professionals.

Discussion

Inspired by anecdotal evidence and recent statistics outlining a decrease in diverse representation in the field, this research serves to find scientific truth alongside voices of shared personal experiences within the Computing industry. With diversity and inclusion on every organization's to-do list, transparency and direct feedback on which actions are working to promote equity within the workforce will be crucial in moving our industry forward.

At the start of this study, two research questions were posed to establish the direction of participant inquiries. These research questions were: 1) Why do underrepresented, diverse professionals exit STEM fields and 2) What improvements can organizational leadership implement to retain and grow diverse employees?

The findings from this research stemmed from three participant themes: compensation equity, representation, and an inclusive work environment. These themes were identified from participant responses which included both personal experiences and insight into suggestions for field improvements that could assist with retaining and growing diverse Computing professionals.

Compensation Equity

"Fair and equal pay."

"Offer more benefits and access to promotions."

"Acknowledging experience, equal pay, and benefits..."

"I received lower pay than my male coworkers"

"Female employees get paid way less."

"There is often disparity in pay and on-site opportunities."

Survey participants reiterated three axial codes which formed the larger selective code, compensation equity. The identified axial codes were equal pay, benefits, and pathways to promotion.

Fry et al., (2021) conducted a research study that highlighted issues of compensation equity across STEM professions. Its findings indicated the median earnings of women in STEM occupations was 74% of men's median earnings in the same occupation. This percentage narrowed from 72% in 2016 (Fry et al., 2021). Likewise, racial and ethnic earning gaps in STEM professions indicate the median earnings of Black workers at 78% of the median earnings of White workers in STEM. This gap has widened since 2016 when the Black vs. White earnings gap in the STEM workforce was 81% (Fry et al., 2021). Black and Hispanic women earned the lowest median annual earning at $57,000 annually compared to white women earning $66,200, Black men earning $69,200, Hispanic men earning $73,000, and White men earning $90,600. Earning the highest median annual salary was Asian men at $103,300 (Fry et al., 2021).

With education being a consideration of compensation equity, women, Black, and Hispanic degree seekers are underrepresented in Engineering and Computer Science degree programs. In surveying STEM professionals, 52% of participants theorized this underrepresentation is due to inadequacies in quality education to prepare Black and Hispanic youth for the STEM fields. 45% of professionals surveyed attributed these disparities to a lack of encouragement to join STEM fields at an early age (Funk & Parker, 2018). An inability to see themselves in STEM roles through examples of other diverse professionals could also contribute to underrepresentation. Similarly, Native Americans, Native Hawaiians, Pacific Islanders,

and people who identify with more than one racial group earned 4% of bachelor's degrees and 3% of advanced degrees in STEM fields" (Fry et al., 2021).

Representation

Women represent less than 28% of the science, technology, engineering, and mathematics (STEM) profession (American Association of University Women [AAUW], 2020). Racially diverse representatives make up less than 37% of STEM professions (Fry et al., 2021). Both gender and racially-diverse professionals exit STEM fields at a disproportionate rate compared to their Caucasian male counterparts (Fry et al., 2021).

Survey participants reiterated three axial codes which formed the larger selective code, representation. The identified axial codes were diverse and transparent recruitment, mentoring and cross-training, and diverse leadership.

Diverse & Transparent Recruitment

"More people like me."

"Recruiting from non-traditional pipelines."

"Don't only hire referrals."

"Diversity is a cycle, so place emphasis on hiring/recruiting outside of the box too. The more diverse talent you can bring in, the more you reduce tokenism and encourage a culture where DEI is second nature and not just a box that needs to be checked every year."

With an increase in promises for diversity and inclusion, technology companies have fallen short of realizing the closure of the ever-present diversity gap. As an example of the industry's diversity pursuits, Google has adopted a transparent model of progress reporting through its Diversity Annual Report. Google's Diversity Annual Report 2022 shows improvements from 2021, however, the divide between both gender and racial diversity remains significant. For 2021, Google hired 44.5% White+ (30.8% men, 13.7% women), 42.8% Asian+ (27.7% men, 15.2% women), 8.8% Black+ (5.4% men, 3.4% women), 8.8% Hispanic and Latinx+ (6.2% men, 2.5% women), 0.7% Native American+ (0.5% men, 0.3% women) employees (Google, 2023). In 2022, Google hired 40.5% White+ (25.4% men, 14.8% women), 46.3% Asian+ (28.9% men, 17.4% women), 9.4% Black+ (5.0% men, 4.3% women), 9.0% Hispanic and Latinx+ (5.8% men, 3.2% women), and 0.8% Native American+ (0.5% men, 0.3% women) employees. (Google, 2023). The data provided by Google provides a picture synonymous with findings across the computing industry of disparities in hiring and representation.

In considering recruitment for diverse candidates, many technology companies follow the same routine with partnering with diverse academic organizations, making a few rounds at HBCUs (Historically Black Colleges and Universities), and courting diverse professionals at recruitment events while staying geographically close to home with recruitment efforts. This strategy of geographic-central recruitment fails to leverage the remote capabilities of a technical industry to reach areas where diverse populations are more prevalent. Between the years 2005 – 2017, more than 90% of technology companies and associated technology growth were based in New York, Boston, San Francisco, and San Jose with recruitment efforts centering on these locations (Chakrovorti, 2020). In a post-COVID world where remote technical work is prevalent – and often preferred among employees – technology companies must leverage the backbone of their technical industry to embrace the remote culture, recruit from geographically diverse locations, and

create partnerships outside of their comfort areas. Chakravorti, 2020 established a research initiative, *Imagining a Digital Economy for All (IDEA) 2030* which identified two key measures for the expansion of diverse recruitment efforts: 1) Tech Talent Diversity Score and 2) Digital Readiness. The "Tech Talent Diversity Score" analyzes the proportion of underrepresented professionals in the tech pipeline and its distribution across the U.S. The second measure of "Digital Readiness" assesses each state's potential for remote workforce accessibility. Six states that rank high on the Tech Talent Diversity Score are Georgia, Texas, Delaware, Virginia, Connecticut, and Maryland. By reaching diverse populations in these states, organizations within the industry can expand their workforce with gender, racial, and geographically diverse talent.

Through the recruitment and selection process, organizations should strive for transparency and honesty in hiring practices. A transparent, diverse-centric recruitment process should: 1) be conducted in locations that represent diverse populations, 2) identify candidates based on a blind-screening methodology (Castagnetti, 2020), 3) include a "Sample Work" test with blind review where candidates can demonstrate their capabilities relevant to on-the-job responsibilities, 4) include diverse interview panels, 5) include structured interview questions and a ranking indicator for candidate review, and 6) all interview panel participants should complete a semi-annual unconscious bias training. Through these steps, organizations can promote a more fair and transparent recruitment strategy to eliminate unconscious and similarity bias.

Mentoring and Cross-Training

"It's tough to find a mentor."

"We need mentors that are not so overwhelmed they have nothing to pour into others."

"Recruit, coach, and train more diverse interns, providing early equal opportunity."

"The office had diversity groups in which my fellow WOC could have safe spaces to chat and meet each other. The conversations were rarely about discrimination in the workplace, but rather a chance for us to meet and make friends with other people without the fear of implicit discrimination. This boosted my confidence as I was able to talk to more seasoned professionals about my career and feel like my ideas were important. Then this confidence carried through into the general workspace."

Mentorship and cross-training are two of the most effective methods of which to remove barriers to diversity in the workplace (The White House, 2021). Mentorship serves as a support system and a way for the employee to see themselves through someone who can relate to their personal experience. In evaluating the requirements for an effective mentorship program, Means Coleman and Reyes, 2021 provide a framework with benchmarks of efficacy. This framework requires that mentorship programs 1) provide resources to support research and productivity, 2) develop a sense of belonging and well-being, 3) promote health and work-life balance, and 4) prepare for leadership and role advancement. In assessing the success of mentorship and cross-training efforts, the following should be evaluated: 1) communication, 2) the mentoring process, 3) the mentee's growth, 4) the mentor, and 5) the perception of the program. Following a similar peer mentoring structure to this recommendation, Wu et al., 2020, conducted an eight-year study, from 2011 to 2019, which followed 150 first-year, female students majoring in engineering at the University of Massachusetts Amherst. Recruiting 58 junior/senior student mentors – 32 women and 26 men, participants were trained in effective mentorship and assigned a mentee-mentor pair. Following the first year of mentorship which included an average of four meetings per year, female mentees with female mentors reported an improved sense of belonging, motivation, and confidence. Following this structure, organizations can improve diversity success with mentorship and collaborative opportunities (Wu et al., 2022).

Alongside mentoring opportunities, candidates should be allowed to cross-train in areas of interest or future

promotion. Cross-training opportunities allow for the expansion of skills and an opportunity to meet new team members. According to Dobbin & Kalev, 2022, cross-training can result in a bump of 3% to 7% of white women, black men and women, and Asian-American men and women promoted to management.

Diverse Leadership

"Provide leadership opportunities to diverse employees."

"Executive board diversity"

"Give Young Women a chance to lead."

"Upper management should lead by example…"

According to the Global Gender Diversity 2022 report, only 5% of CEOs are women, 28.2% of board members are female, and women represent 19.2% of corporate leadership teams or C-Suites. As of 2021, nearly 90% of Fortune 500 CEOs are white men. Only two Fortune 500 CEOs are black women (Tómasdóttir, 2021).

While diverse team members are a necessity for a fresh perspective and inclusive work environment, diverse leadership reinforces a sense of belonging and improved confidence. Bourke & Titus, 2019 found that teams with inclusive leaders are 17% more likely to report high performance, 20% more likely to make high-quality decisions, and 29% more likely to report collaborative behavior. Teams with inclusive leadership also experienced a 10% improvement in work attendance by almost one day a year per employee (Bourke & Titus, 2019).

Inclusive Work Environment

Survey participants reiterated three axial codes which formed the larger selective code, inclusive work environment. The identified axial codes were diversity training, flexible work environment, and empathy.

Diversity Training

"Use DEI training that actually teaches about concepts like microaggressions and unconscious bias, shows a wide range of discrimination, encourages allyship, and challenges all employees to have difficult conversations and self-reflection."

Diversity training was one of the most referenced codes in this study with several participants offering it as a suggestion for diversity improvements. While diversity training has always served as an organizational solution to diversity checkboxes, the effectiveness of diversity and bias training is dependent on its implementation and enforcement by leadership. Mandatory diversity training is often recycled year after year with employees getting in the habit of clicking through the content without engaging in a conversation regarding inclusion and culture within the workplace.

Roberson et al., 2020 offered a learner-centric, process-based model of diversity training that considers learning concepts and the characteristics of the learner through pre-training, training, and post-training environments with self-regulatory structure. This is conducted via needs analysis which can identify the knowledge, skills, and behaviors needed for an individual employee – or a team of employees. Progression throughout the training allows participants to identify, confront, temper, or modify their emotions towards diversity topics while also learning to value diverse relationships within their workplace. Through this

learner-centric, needs-based methodology of training, trainers can provide tailored content that meets the needs of the organization.

Flexible Work Environment

"I have been assaulted twice, screamed at over my desk. I've been sexually harassed a few times, I had to complain repeatedly about my director hugging me and calling me terms of endearment that made me very uncomfortable. I just saw how upper management did not know how to handle these things when brought to their attention. Working remotely has helped not being put into these situations."

"Finally, allow flexibility for working hours/locations wherever possible. Working moms AND dads should be able to take care of their children, those with disabilities or illnesses should be able to take care of their health, and employees from other countries should be able to visit their families for extended periods without being penalized when it comes to promotions, raises, or just general treatment from management or peers."

During the pandemic and the recession to follow, women – particularly, women of color – have lost over 5.4 million jobs (nearly 1 million more than men) (Boesch & Phadke, 2021). The COVID-19 pandemic brought uncertainty in childcare and an inability to depend on family support structures due to health concerns which prompted the exit of millions of women from the American workforce. This decline in employment set women's employment parity back an entire generation with the potential for gender parity realization updated to reflect 132 years from now (World Economic Forum, 2022).

Following the onset of the COVID-19 pandemic, the adoption of the flexible work environment caused a significant shift in the way many organizations conduct business. With many technology companies prioritizing a remote-first approach, flexible work environments can be an incentive to both gender and racially-diverse professionals. While this is a positive change, generalizations have been made in recent research that flexible work policies are a gendered benefit that reinforces gender roles that persist in most modern countries (Borgkvist, 2021). The offer of flexible working arrangements should be promoted as a "gender-neutral" benefit with value placed on attending to family (and other responsibilities) as essential challenging the ideal worker norm of gender role responsibilities (Borgkvist, 2021).

Finally, another benefit to flexible work arrangements which was pointed out by several respondents was that of freedom from discrimination and harassment. Funk & Parker, 2018 found that 22% of women in majority-male workplaces STEM roles reported sexual harassment at work. This research also found that 62% of Black participants, 44% of Asian participants, 42% of Hispanic participants, and 13% of white participants experienced discrimination in their STEM role. Flexible work arrangements limit direct contact with colleagues which will significantly reduce the opportunities for harassment and discrimination within the workforce.

Empathy

"Treat others as you want to be treated."

"Think before you speak."

"Empathy, Compromising, Listening."

"Hire better people that are kind-hearted."

"More listening and understanding."

"Promote cooperation instead of competition."

"Open communication & collaboration."

Empathy refers to the "affective response more appropriate to another's situation than one's own" (Hoffman, 2000). Hoffman, 2020 builds upon historical research which classifies empathy as a teachable skill that requires a personal choice to aid in its implementation. With reference to Zaki's *The War for Kindness: Building Empathy in a Fractured World,* empathy is defined in three stages: 1) Sharing, 2) Thinking About, and 3) Caring About. Survey participant feedback all aligned with Zaki's three stages of empathy with common themes of Fairness, Equality, and Kindness. With survey participants providing optimistic hopes for the future, they also shared experiences with sexism, racism, microaggressions, and missed career opportunities due to their differences.

The most common shared experience of survey participants was that of daily microaggressions which made it challenging to focus on their day-to-day work requirements. The term, "microaggression" was originally coined in 1970 by Dr. Chester Pierce who used the term to define "any subtle insult or informal degradation of a member of any socially marginalized group" (Parikh & Leschied, 2022). While many organizations vocalize a zero-tolerance discrimination policy, microaggressions often occur as quick interactions lacking context to avoid direct conflict. Survey participants referenced examples of microaggressions including always being the pun of jokes, male colleagues having to repeat a female colleague's statement for it to be acknowledged, minority or diversity hire comments, and being forced to perform administrative tasks outside of my job responsibilities. To prioritize empathy and minimize negative experiences by diverse professionals, colleagues must choose to become allies. To practice allyship and empathy within the workplace, consider the following steps: 1) Consider what minority colleagues may experience in the workplace, 2) Form a connection – or two, or three! – with someone that does not look like you, and 3) Think before you tell that joke or make that insensitive remark. Through these actions and in consideration of the direct feedback included from survey participants, our Computing field can move towards a more inclusive, empathetic workplace.

Retention

Computing leaders must emphasize hiring, fostering, and protecting diverse employees in Computing fields. With consideration of our selective code findings of 1) Compensation Equity, 2) Representation, and 3) Inclusive Work Environment, the following diversity plan should be considered by organizational leadership.

1) A Top-Down Approach

Diversity initiatives should be implemented at the leadership level with a diversity task force with direct engagement with all organizational staff for iterative feedback.

Diverse professionals should have representation in all leadership layers within the organization.

2) Opportunities for Everyone

Organizational recruitment should include underrepresented communities with internships and scholarships for minority and women representatives.

Interview panels should include participants that look like the candidate for hire.

3) Mentorship

Implement cross-functional mentorship programs for diverse professionals to learn new skills, develop pathways to promotion, and form new relationships with colleagues.

4) Identify Wage Bias

Complete an organization-wide wage review to identify and remedy pay disparity.

5) Get Tough on Discrimination

Allow anonymous self-reporting of discrimination/harassment that is reviewed by the Diversity Task Force, Organizational Leadership, and Human Resources (HR).

Provide swift investigations and resolution in serious offenses. Provide coaching for minor incidents.

6) Get Together!

Schedule frequent, informal training and discussions related to topics of diversity.

Allow frequent in-person engagements for team building.

In addition to these foundational requirements, organizational leadership should survey their employees for feedback on their workplace experience. Likewise, a review of recruitment efforts and recent diversity employment should be evaluated to determine whether recruitment strategies are offering adequate opportunities for diverse professionals.

Future Research

This research was conducted via a SurveyMonkey survey targeting Computing professionals through SurveyMonkey Audience, LinkedIn, and shared requests for participation to local university systems. With a sample size of 330 participants from both gender and racially diverse backgrounds, this study assists in providing a framework for future research efforts into the current state of diverse representation and opportunities for diverse professional retention within the Computing industry. Future research efforts should consider ethnicity factors and LGBTQ+ professionals and their experiences related to workplace recruitment, hiring, and retention. Future research should also consider a larger sample size targeting various areas of the United States for a more complete picture of diverse employee experience.

Conclusion

Women represent less than 28% of the STEM profession (AAUW, 2020) while racially diverse representatives make up less than 37% of STEM professions (Fry et al., 2021). Both gender and racially-diverse professionals exit STEM at a disproportionate rate compared to their Caucasian male counterparts (Fry et al., 2021).

Utilizing SurveyMonkey Audience, LinkedIn survey sharing, and survey sharing with various Universities, 330 participants provided their responses to solve the intended research questions: 1) Why do underrepresented, diverse professionals exit STEM fields and 2) What improvements can organizational leadership implement to retain and grow diverse employees? The feedback from participants was analyzed utilizing an iterative, grounded-theory approach with open, axial, and selective coding. Coding results identified the findings of 1) Compensation Equity, 2) Representation, and 3) Inclusive Work Environment as being the three common challenges faced by diverse Computing professionals. Each category provides expanded participant feedback and suggestions for executive leadership to implement to begin improving the diverse culture within their organization.

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Appendix A
Research Instrument/Survey

Page 1 – Disqualifying Questions

1) Are you a current or former professional within the Computing field (Computer Science, Cyber Security, Information Systems, Information Technology)?
    a. Yes
    b. No

2) Are you a gender or racially diverse representative within the Computing field?
    a. Yes
    b. No

Page 2 – Demographics

3) What is your gender?
    a. Female
    b. Male
    c. Other (Please Specify)

4) Which race/ethnicity best describes you? (Please choose only one.)
    a. American Indian or Alaskan Native
    b. Asian/Pacific Islander
    c. Black or African American
    d. Hispanic
    e. White/Caucasian
    f. Multiple ethnicities/Other (Please Specify)

5) What is your age?
    a. 18-24
    b. 25-34
    c. 35-44
    d. 45-54
    e. 55-64
    f. 65+

6) What is the highest level of school you have completed or the highest degree you have received?
    a. Less than high school degree
    b. High school degree or equivalent (e.g., GED)
    c. Some college but no degree
    d. Associate degree
    e. Bachelor's degree
    f. Graduate degree

7) Which of the following categories best describes your employment status?
    a. Employed, working full-time
    b. Employed, working part-time
    c. Not employed, looking for work
    d. Not employed, NOT looking for work
    e. Retired
    f. Disabled, not able to work

8) How many years of experience do you have within the Computing field?
    a. Less than one year
    b. 1-2 years
    c. 3-4 years
    d. 5-6 years
    e. 7-9 years
    f. 10+ years

9) Which job level best describes your current position?
    a. Entry Level
    b. Intermediate Level
    c. Middle Management
    d. Senior Management
    e. Owner/Executive/C-Level
    f. No longer employed within the field.

Part 3 – Research Subject Questions

10) Leadership within my organization considers diversity and inclusion a priority.
    a. Strongly Disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly Agree

11) I have colleagues that look like me within my team.
    a. Strongly Disagree.
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly Agree

12) I feel a sense of belonging on my team.
    a. Strongly Disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly Agree

Page 4 – Open-Ended Questions

13) Have you ever considered leaving the Computing field as a result of employment inequity? Please share your experience.

14) What could be done to improve workplace experience, equity, and retention for diverse professionals?

Appendix B

Google Diversity Annual Report – Intersectional Hiring