



## UNEQUAL CULTURE OF WOMEN AND MINORITIES IN CYBERSECURITY DOMAIN

D. O. Egete<sup>1</sup>, B. I. Ele<sup>2</sup>, and D. U. Ashishie<sup>3</sup>

Department of Computer Science, University of Calabar, Calabar, Nigeria

<sup>1</sup>Email: [davidobobo@gmail.com](mailto:davidobobo@gmail.com), +234(0)8037204626

<sup>2</sup>Email: [mydays2020@gmail.com](mailto:mydays2020@gmail.com), +234(0)8064451381

<sup>3</sup>Email: [ashishiedenis@gmail.com](mailto:ashishiedenis@gmail.com), +234(0)8063128660

### Cite this article:

D. O. Egete, B. I. Ele, D. U. Ashishie (2023), Unequal Culture of Women and Minorities in Cybersecurity Domain. British Journal of Computer, Networking and Information Technology 6(1), 11-19. DOI: 10.52589/BJCNIT-Q1MZPVWZ

### Manuscript History

Received: 26 June 2023

Accepted: 12 Aug 2023

Published: 4 Sept 2023

### Copyright © 2023 The Author(s).

This is an Open Access article distributed under the terms of Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0), which permits anyone to share, use, reproduce and redistribute in any medium, provided the original author and source are credited.

**ABSTRACT:** *Women and ethnic minorities have historically been underrepresented in the cybersecurity industry. Although there are an increasing number of open opportunities in the cybersecurity industry, this pattern has not changed. There is still an imbalance in the participation of women and ethnic minorities in the cybersecurity domain. Issues that impact both Africa and the global participation of women and ethnic minorities in cybersecurity include inadequate representation and awareness as well as retention problems. Further, issues such as harassment, gender bias and the idea that cybersecurity is a “man’s world” are also contributing factors. This paper provides a framework for discussing some of the skills that are available to women and underrepresented groups and argues for the necessity to solve this problem. Programs striving to increase the participation of women and ethnic minorities in cybersecurity are discussed. Lastly, some suggestions to remediate this pervasive issue are also provided.*

**KEYWORDS:** Women, Minorities, Cybersecurity, Culture, Participation, STEM



## INTRODUCTION

Culture is made up of the customs, attitude and rules of society. It is a general trust that a more assertive, self-assured and formidable group while women are less confident, unresolved, noncommittal by nature, and weak in the cybersecurity domain ((Esin, 2018; Hu, 2014; & Elan, 2012). As LeClair & Pheils (2016) and Esin, (2019) noted, despite gender stereotyping and culturally bias idea in the weakness of women in the domain of cybersecurity, it is worth noting that women and minorities continue to aspire as firm contributors in the battle against cyber-attacks and cyber-threats on the helpless innocent citizens. The development of computer system after the Second World War witnessed less than adequate participation of women and racial minorities in cybersecurity. The retention of the few women and minorities who embraced cybersecurity careers remains at a dismal low level revealing that most of these women and minorities lag in pursuing a cybersecurity career. It is time to revisit the over prolonged cybersecurity career policy, re-engage women and minorities based on their intellectual competence not on corporeal competence (Ngwang, 2018; and Esin, 2019). To eradicate the looming inequalities, it is critical to envisage and engage an intelligence mitigation plan of action aimed at dismantling the baggage of gender stereotyping, which has hitherto suppressed talented women and minorities.

Though women are underrepresented in Science, Technology, Engineering and Mathematics (STEM) fields globally, Africa is lagging even worse behind (Dube, 2015). Numerous factors contribute to this issue; this includes educational issues (school attendance, educational opportunities), issues faced when entering the workplace (inclusivity issues in recruitment, delayed career advancement) and finally systemic issues (gender bias and discrimination). School-attendance statistics indicate that young girls are being left behind, and limited educational pathways and programmes further exasperate the pervasive, systemic challenges (UNESCO, 2021). Considering the reduced number of cybersecurity professionals trained in Africa, compounded with a global underrepresentation of women in the field, women in Africa are left in a particularly unfortunate situation.

Undergirding this initiative should be the irresistible willpower to ensure that the enrollment policy for cybersecurity professionals is organized to include women and minorities. From a spiritual view of creation, the male concept of the leadership role of men created a common ground for systemic men governance in all aspects of life including the cybersecurity profession. However, human growth has revealed that women can do as much of everything men do, if not better. As a result, today, men are strongly encouraged to accept professional alliance with their women and minority compatriots as partners who complement each other's roles and responsibilities.



## FRAMEWORK

Per (Tsai, 2016) and (Hu, 2014), participation of women and minorities in cybersecurity workforce remains unequal in spite of insignificant progress. Irrespective of the recent innovative growth and development by women and minorities in all aspects of industry, their representation in cybersecurity continues to remain dormant. Amid this remarkable growth and contribution, what is next? The first school of thought asserts that the unequal culture of women and minorities in cybersecurity is due to their ineffectiveness, incapability to advance in the profession, discrimination, and the feeling of inadequacy or simply male prejudice. The second school of thought is the one I subscribe to, focuses on a more progressive and liberal view of women and minorities who have challenged the myopic concept of gender and racial inadequacy, the continuing progress and groundbreaking shift in the millennial population evidences most women and minorities under the ages of 30-35 completing their undergraduate and graduate degrees in computer science and information security on the planned dates and time with males and other majority groups. Chabrow (2011), in his studies on women and minorities scarcity in information technology (IT), cautions that the world community must continue to embrace the prototype change of the millennial populace as a target to eradicate gender penchant and men prejudiced approach on unequal culture of women and minorities in the cybersecurity profession. Recognizing and supporting the millennial population's academic ambition and accepting them as active partners in cybersecurity professional is the way forward as a well-thought out measure to bridge the gender gap in the profession.

## UNEQUAL CULTURE IN CYBERSECURITY OPERATION

Shelving or ignoring women and minorities in cybersecurity operation is the same as to the denial of equal opportunity to protect and defend the global community in the day-to-day battle against perpetrators of cyber-threat and cyber-attack. Per Benison (2009), Shumba (2013) and Brotherton & Berlin (2017), the remedy to decrease the unequal ethos of male dominant slant and enforcement of complete mitigation plan of action must include collaboration and principled agreement between men, women and minorities, urging them to step out of insulated arena and be ready to defend and protect helpless citizens against imminent cyber-threats and cyber-attacks. The envisioned cybersecurity professional alliance must be structured to overcome human identity and accept the fact that cyber-threats and cyber-attacks are active and imminent living forces on the threshold of launching wide-ranging assault on men, women, minorities and organizations (Elan, 2012; Dallaway, 2013; and Weiss, 2016). Notably, the cyber world stands in need of collective strength against the current disproportionate slant of male, women and minorities to establish effective cyber-defensive and protective security mechanism to protect private and public organizations and innocent citizens. Women and minorities are engrained with an inexhaustible repository of untapped expertise that will inevitably prepare current and future cyber-experts in the battle against invisible every day and any moment perpetrators of cyber-attacks. As Weiss (2016) concludes in his studies, the biggest problem women and other minorities face in the workplace is the unequal treatment of women and minorities as a result of a narrow-minded favoritism grounded on the gender predilection for male chauvinism, and this unfortunate work relationship is detrimental to the global plan of action against the battle of cyber-threats and cyber-attacks, sustainable collaboration and principled agreement between men, women and minorities to battle heartless perpetrators of cyber-attacks. Again, what is next" must involve the eradication of men's narrow-mindedness, which has deprived capable women the



opportunity to contribute to the defense against cyber-attacks. A plethora of women and other minorities have been trailblazers in cybersecurity operations and have accumulated untapped intellectual capability and the willingness to contribute to the stability of global economy and security. Today is the right time for the world of academics to tap into and use this knowledge for the protection of cyber development and safety.

## **WOMEN AND MINORITY INTELLECTUAL TALENTS**

Despite gender stereotyping and cultural beliefs about the intellectual and scientific inferiority of women and minorities, women and minorities continue to aspire as unwavering contributors in the battle against global security. As Esin (2019) noted, the 21st century women and minorities are ascending and matching the success ladders of their men counterparts. Unfortunately, women and minorities contributions to cybersecurity profession are sidelined for no perceived reason, except for the fact that the traditional and religious notion that tended to dictate gender relationships was that men were often projected as assertive, self-assured and formidable in the society. The women have been often been relegated to the home, childbearing and child caring and cooking. However, and undeniably, women and minorities have also been the leading contributors in battle to defend and protect the global community:

- i) In 1940, Elizabeth Smith Friedman, (minority & woman) helped to invent the science of cryptography for the United States Federal Bureau of Investigation (FBI). Her techniques broke international spy rings decoded three Nazi Enigma machines and contributed to the early work of the forerunner to the Central Intelligence Agency (CIA). Right after the war, her elite code-breaking unit was shut down and various men took credit for her work (Poster, 2012; Browne, 2015; & Shumba 2013).
- ii) In the 1950s, an African American female, Katherine Johnson, (minority & woman), a mathematician at NASA calculated the aeronautical trajectories to put Man on the Moon. The proportion of minority and women in computer science grew until the mid-1980s. Again, right after the discovery, the dawn of personal computing evolved swiftly (Poster, 2012; Browne, 2015; & Shumba 2013).
- iii) In 2009, Melissa Hathaway, (minority & woman) served as President Obama's first acting senior director on cyberspace for the National Security Council (NSC) (Poster, 2012; Browne, 2015; & Shumba, 2013).
- iv) In 2004-2010, Letitia Long, (minority & woman) was the first woman director of the National Geospatial-Intelligence Agency which supplied the satellite, geographical and social-media data that enabled the capture of Osama bin Laden (Poster, 2012; Browne, 2015; & Shumba 2013).
- v) In 2013-2016, Dr. Jane LeClair (minority & woman) served as the Chief Operating Officer, providing outstanding leadership for the National Cybersecurity Institute dedicated to increasing knowledge and expertise in the cybersecurity discipline (Esin, 2018; LeClair & Keeley, 2015).
- vi) From 2016 to present, Dr. Jane LeClair (minority & woman) established Washington Center for Cybersecurity Research and Development (WCCRD), an organization dedicated to the advancement of skills, knowledge and competency of minority



women and men in cybersecurity education. She organized and convened conferences and training across the globe (LeClair & Pheils, 2016; & Esin, 2018).

- vii) On January 19, 2019, thousands of women and minorities across fifty states of the continental United States were committed, dedicated and willing to strengthen their individual talents and protection of vulnerable citizens against cyber-attacks and cyber-crimes (Esin, 2019: 6-7).

## **MITIGATION**

Women and minorities' talents are often diluted, prohibited and dominated by male-dominating and Caucasian's majority approach often given limited or no line of authority. The egotistic and male narrow-mindedness often modulates minority and women's ability to become active operators in cyber-security that demands diverse skills, talents and intellectual contributions to battle perpetrators of cyber-attacks on vulnerable innocent citizens (Shumba, 2013; Benison, 2009; Ngwang 2018, Esin, 2019). Cybersecurity operations amplify the ethos of protecting and defending world organizations against cyber-threat; and echelons of battling cyber-attacks and cyber-threats is an all-embracing responsibility requiring participation and contribution of men, women and citizens of the global community. Today, cybersecurity unemployment rate has dropped to Zero-percent; however, the global benchmark relative to talented cybersecurity professionals is not enough to curb the growing epidemic of cybercrime and cyber-attack and to counteract spiteful attacks against vulnerable innocent communities (Shumba, 2013; Benison, 2009).

There are millions of job opportunities ahead of the current and future generation; hence, the present-day parochial approach must be eliminated single entity has adequate resources to battle the global cyber-threats. Per LeClair & Pheils (2016) and Shumba (2013), comprehensive outreach is the key to eradicating existing cyber-attacks and this strategy must include and increase the low statistics of women and minorities entering the cybersecurity workforce. Private and public organizations and high education enterprises must be willing to step forward with significant plans of action to attract and retain women and minorities: otherwise the unbalanced culture of women and minorities in cybersecurity will continue as anticipated to lead to the explosion of the destruction of global efforts to battle cyber-threats. Over a quarter-million positions in cybersecurity domain continue to remain unfilled in most nations and there is a projected shortfall of 1.5 million cybersecurity professionals in the United States by 2020 Esin, 2018: Hu, 2014; and Elan, 2012).

Men cannot only fill these positions. There are minorities and women willing and eager to fill these positions, but the intransigence of males and majority chauvinism stand in the way of positive engagement of these disadvantaged groups.

## **CLOSING THE GAP**

To address the scarcity of women and ethnic minorities in cybersecurity, various groups must address the lack of opportunities afforded to women and ethnic minorities. Critical stakeholders, such as government, industry and academia must implement strategies to address the myriad issues deterring women and ethnic minorities from entering this workplace (Burrell & Nobles, 2018).





While global perspectives and recommendations to close the gender workforce gap certainly apply within the Africa-context, further steps may be required to address the gender disparity. Within Africa, the most prominent hurdle that must be overcome is increasing female participation in higher education. A sizeable challenge remains in accessing equitable, quality education for adolescent girls. Further policymaking and interaction with various stakeholders must continue to attempt to close the educational attainment gap (UNESCO, 2022).

A leaky pipeline of women in cybersecurity has been discussed; women are not well-enough retained in cybersecurity environments. Various considerations can be made to retain or recruit a more diverse workplace. To improve and encourage female workforce participation within cybersecurity, the ISC2 Cybersecurity Workforce Study has indicated that the top investments to address for women are (ISC2, 2021):

- i) Invest in training;
- ii) Providing more flexible working conditions;
- iii) Invest in certifications;
- iv) Invest in diversity, equity, and inclusion initiatives;
- v) Hire for attitude and aptitude and train for technical skills;
- vi) Provide well-defined career paths;
- vii) Encourage women and minorities to pursue STEM degrees in college;
- viii) Establish organisation diversity goals;
- ix) Establish mentorship programs; and
- x) Address promotion gaps if they exist within an institution.

All these initiatives can help promote women pursuing cybersecurity careers and thus contribute to the global cybersecurity workforce. Because of the family responsibilities that many women undertake, another key initiative would be the provision of flexible working conditions. The ISC2 Cybersecurity Workforce Study also shows that such a provision would help to diversify cybersecurity (ISC2, 2021). Flexible working conditions would afford women the opportunity to organise scheduling, work times and environment to still handle family responsibilities, if necessary. Strict onsite requirements with set hours disempower both men and women to be able to tackle family-related matters. Recent studies have found that women, much more than men, must adjust their careers for family-related matters and experience significant career interruptions as a result (Schaeffer, 2022).

Further, numerous initiatives to provide mentoring and training of young, female cybersecurity talent can help address this shortage. Many universities, non-profit organisations and professional bodies have initiatives to foster mentor and mentee relationships. Within SSA, “Women in Cyber” is an initiative targeting women residing in East Africa, offering training and assistance. These initiatives can address issues of lacking



role models, as well as provide women with critical skills needed to enter the cybersecurity workforce.

It is essential that cybersecurity becomes more receptive welcoming women. A key contributing factor is the usage of real-world applications and exposure to industry. One of the solutions in this domain could be learning factories. To support investment in training, learning factories can provide much-needed skill improvements. Learning factories can be run by organisations to provide learning activities, real-world applications, information sharing and skills development. It affords graduates, workers, and new employees the opportunity to be exposed to key activities that will support their career growth and development. A learning factory can assist with action- and practice-based learning to strengthen the learner's ability to apply themselves within a practical environment.

Other techniques that should be adopted to help recognize the efforts of women include (Poster, 2018) (Maigret, 2022):

**i) Acknowledge the contributions of women:** The list of women contributing to STEM is much longer than the public may believe. Raising awareness of the invaluable contributions women have made to STEM and cybersecurity is crucial to promoting the participation of women in cyber. Contributions are often overlooked and under-appreciated (Austin, 2022). For example, during the Second World War, it was not public knowledge that around 10,000 women carried out message decryption. Furthermore, there have been various female scientists like Hedy Lamarr and Elizabeth Smith Friedman, who invented encryption methodologies that were applied in various military equipment at the time.

**ii) Recognize diverse expertise:** Both men and women can bring diverse skillsets to a team. Diverse teams with differing viewpoints tend to be more creative and resilient.

**iii) Encourage young women to pursue STEM-related degrees and careers from an early age:** Parents and teachers must encourage young girls to consider these fields, as there are ample opportunities within the ever-expanding STEM disciplines.

**iv) Create mentorship programs at various levels:** These can be introduced as early as primary school to provide successful models for girls; and can be implemented at any level of development, even for junior professionals.

**v) Dismantle bias in hiring practices and train all employees equally:** Workplaces should not just afford these opportunities to executives; all employees should feel involved, valued, and respected.

**vi) Prioritise creating and supporting leadership positions for more women:** Active leadership promotion for women so that women can also gain experience concerning project and management responsibilities.



## CONCLUSION

Internationally, there are not enough cybersecurity professionals and cyber operation is experiencing a growing shortage of skilled personnel. Men chauvinism and discrimination contribute largely to unequal culture of women and minority in cybersecurity domain. Men often hold high-level directorship and managerial positions, whereas, women and minorities routinely occupy entry-level and non-managerial positions. It will take collective societal efforts to eliminate the looming inequalities and to dismantle the baggage of gender stereotyping that result in suppressing talented women and minorities from contributing to global security operations. The study adds to the body of knowledge on workforce gaps in the cybersecurity industry and asserts that there is no single factor significantly contributing to the underrepresentation of women and minorities in this field. The article explains the complexity of these elements while demonstrating how they might be systematized to draw women and minorities into the cybersecurity profession.

The cybersecurity industry now has a gender-asymmetric workplace as a result of the persistent and systematic difficulties women and ethnic minorities experience in Africa and globally. While there are similar entry obstacles for women and ethnic minorities in Africa, some particular experiences make their condition worse. Negative gender representation in cybersecurity is impacted by issues with bias against women, unfair hiring practices, and bottlenecks in opportunity and advancement. Furthermore, in Africa, widespread poverty, a lack of educational opportunities, and other institutional issues make it more difficult for women to enter STEM disciplines. Although strategies to address this gender gap have been laid forth, it may still exist without active assistance from diverse stakeholders. In order to reduce the gender gap in cybersecurity, both in Africa and globally, comprehensive programs must be created.

## REFERENCES

- Austin, K. (2022). The Untold History of Women in Cybersecurity. Retrieved on 22/02/2023 from United States Cybersecurity Magazine: <https://www.uscybersecurity.net/the-untold-history-of-women-in-cybersecurity/>
- Benison, L. (2009) "Are men or women better at it" From <http://www.computerweekly.com/News/2240089131/Are-men-or-women-better-at-it?>
- Brotherston, L. & Berlin, Amanda (2017). Defensive security handbook-best Practice for securing infrastructure. Sebastopol: CA
- Burrell, D. & Nobles, C. (2018). Recommendations to Develop and Hire More Highly Qualified Women and Minorities Cybersecurity Professionals. *International Conference on Cyber Warfare and Security*, 75-81.
- Chabrow, E. (2011). "Women, minorities scarce in IT Security Field". from <http://www.bankinfosecurity.com/women-minorities-scarce-in-Secubield-a-4143>.
- Dallaway, E. (2013). Let's hear it for the ladies: Women in information security. From <http://www.intoscCurity-magazine.com/magazine-features/lets-hear-it-for-the-ladies-women>.
- Dube, T. (2015). Gender Disparities in Educational Enrolment and Attainment in Sub-Saharan Africa. *Journal of Educational and Social Research*, 5(3), 279-284.





- Elan, S. (2012). Study: Women encounter inequality in science & technology fields. Retrieved from --<https://www.elsevier.com/connect/study-women-encounter-inequality-in-science-and-technology-fields>.
- Esin, J. O. (2018). "Eliminating Gender Disparity in Cybersecurity Professions Through Education (WCCRD) <https://www.washingtoncybercenter.com/publications-projects>
- Esin, J. O. (2019). A call for concern: The unbalanced representation of minorities' and women in Cybersecurity Profession. From <https://www.washingtoncybercenter.com/publications-projects>.
- Hu, E. (2014) "Facebook's Diversity Numbers Are Out, And They're What You Expect," <http://www.npr.org/blogs/alltechconsidered/2014/06/26/325798198/Facebooks-diversity-numbers-are-out-and-they-re-what-you-expect>.
- ISC2. (2021). *Cybersecurity Workforce Study*. ISC2.
- LeClair, J. & Pheils, D. (2016). Women in cybersecurity. Albany, New York: Excelsior College Press.
- Maigret, B. (2022). *Break the bias and create a more diverse and inclusive cybersecurity workforce*. Retrieved September 21, 2022, from Engineering News: [https://www.engineeringnews.co.za/article/break-the-bias-and-create-a-more-diverse-and-inclusive-cybersecurity-workforce-2022-07-25/rep\\_id:4136](https://www.engineeringnews.co.za/article/break-the-bias-and-create-a-more-diverse-and-inclusive-cybersecurity-workforce-2022-07-25/rep_id:4136)
- Maiget, B. (2022). *Why Women Are Underrepresented in Cybersecurity*. Retrieved November 23, 2022, from ITNewsAfrica: <https://www.itnewsafrica.com/2022/03/why-women-are-underrepresented-in-cybersecurity/>
- Ngwang, E. N. (2018) The challenges of practical ethics and leadership in the age of cyber education: A crisis in management. *Journal of Educational Research and Technology (JERT)* 7 (7).
- Poster, W. R. (2012). "Global technology diffusion and gender disparity: Social impacts of ICT.
- Poster, W. R. (2018). *Cybersecurity needs women*. Retrieved December 30, 2022, from Natura.com: <https://www.nature.com/articles/d41586-018-03327-w>
- Schaeffer, K. (2022). *Working moms in the U.S. have faced challenges on multiple fronts during the pandemic*. Retrieved March 14, 2023 from Pew Research Organisation: <https://www.pewresearch.org/fact-tank/2022/05/06/working-moms-in-the-u-s-have-faced-challenges-on-multiple-fronts-during-the-pandemic/>
- Shumba, R. et al. (2013) "Cybersecurity, Women and Minority." Proc, ITiCSE-WGR.
- Tsai, P. (2016). "Cybersecurity skills gap? Most organizations lack IT security experts". from <https://community.spiceworks.com/topic/1618495-cybersecurity-skills-gap-most-organizations-lack-it-security-experts>.
- UNESCO. (2021). *International Day of Women and Girls in Science: Addressing and Transforming the Gender Gap*. (K. Mhopjeni, Editor) Retrieved August 29, 2022, from Unesco: <https://en.unesco.org/news/international-day-women-and-girls-science-addressing-and-transforming-gender-gap>
- UNESCO. (2022). *Transformative Education for girls in sub-Saharan Africa*. Retrieved March 10, 2023 from Reliefweb: <https://reliefweb.int/report/world/transformative-education-girls-sub-saharan-africa>
- Weiss, S. (2016). "The Biggest Problem Women Face in The Workplace isn't What You Might Expect." from <http://www.bustle.com/articles/17461-the-biggest-problem-women-face-in-the-workplace-isnt-what-you-might-expect>