E-Mentoring: Building and Sustaining an Online Mentoring Community for Black Women

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Introduction

Lack of role models, structured supports, and cultural affirmation in science, technology, engineering, and mathematics (STEM) fields impact female students of color's interest in science (Aryee 2017). Research reveals these factors play a significant role in a student's decision to enter science-related careers as early as elementary school (Wang and Degol 2013). Recently, there is a renewed focus not only on why this happens, but also how educators can provide opportunities to students at a young age to help them break through familial, cultural, and societal constraints in order to select careers that genuinely interest them. Individuals make the decision to enter certain careers, including science careers, at a young age. Combined, these two strategies of exposure and mentoring have been documented as critical in increasing the interest of groups historically underrepresented, especially Black Women, in STEM overall.

Black, LatinX, and Native American students are considered historically underrepresented or minorities in STEM doctoral programs (National Academies of Sciences, Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce 2019). In 2018 NSF reported, that between 2000 and 2015, the number of black U.S. citizens and permanent residents awarded a bachelor's in science and engineering fields increased from 9% to 10% (NSF 2018). LatinX students who were U.S. citizens or permanent residents receiving a bachelor's degree in science and engineering fields increased from 7% to 13% (NSF 2018). Unfortunately, the number of science and engineering bachelor's degrees awarded to U.S. citizens or permanent residents of American Indian or Alaskan native descent remained at about 1%. The increases noted amongst the Black and LatinX communities is likely due to the population increase as well as an increase in college attendance amongst minorities (NSF 2018). Race-matched connections, such as mentoring, have been shown to validate, affirm, and increase the success of black doctoral students, which will all contribute to their completion of their programs (Felder and Barker 2013).

Mentoring has long been understood as a beneficial component of academic and professional development (Ragins and Cotton 1999). In recent years, mentoring has become a cornerstone approach from K-12 settings through higher education and early career development to

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increasing American performance in STEM and addressing issues of historical underrepresentation in STEM careers (Singh, Bains, and Vinnicombe 2002). Many traditional higher education and early career development programs introduced or deepened a mentoring component of their services. But investigations of the attributes of effective mentoring interactions in STEM are only now starting to shed light on how exactly these complex and dynamic relationships form, evolve, and impact the lives and careers of the current and next generation of STEM professionals. In addition, mentoring in relation to Black Women in STEM has been shown to be critical to recruiting and sustaining this population.

Research suggests that Black girls who have access to relatable, adult Black Women who are able to connect with them in unique ways have lower academic, social, and cultural risks than Black girls who do not have access to gender and race-matched mentors (Dennis, Cummings, and McClendon 2011). Career development programs designed for all women (regardless of minority status) or all minorities (including men) may not take the unique experiences of diverse women into account. Since racially/ethnically diverse women have experiences and perceptions that are unique from women as a group and men of color as a group, identifying and implementing successful mentoring programs has been shown to be critical for the success of Black Women in STEM.

Positive mentoring relationships are not only beneficial to mentees, but Black Women mentors show psychosocial gains from their interactions with Black girl mentees (Thomas 2018). The positive outcomes gained for the Black girl mentees and Black Women mentors can be best described using two of the four principles of Black Feminist Epistemology (Collins 2000):

- Principle #1: criteria for meaning argues that those individuals who lived through the experiences in which they claim to be experts are more credible than those who have not. Essentially, this translates into credibility and trust in the mentoring relationship between Black girls and Black Women.
- Principle #2: use of dialogue in accessing knowledge encourages connectedness and provides contexts for Black girls and women to connect on a deeper level.

The purpose of this article is to highlight the importance of online mentoring communities for Black Women in STEM higher education and the workforce, through examination of existing models and programs. This article explores the importance of online mentoring communities and how they influence Black Women's success in STEM fields. This article aims to advance knowledge for all organizations working to build virtual communities of support for Black Women in STEM. Understanding the benefits and need of establishing an online mentoring community for Black Women has the potential to advance the retention of Black Women in STEM by providing tools and insight to dismantle “One-Size-Fits-All” mentoring programs and allow for strategizes that specifically target Black Women, thus optimizing the effectiveness of such programs.

Background

Factors Contributing to Success in STEM

Indicators of Success in STEM include measures of self-efficacy, high GPAs, completion of degrees, credentials in STEM-related fields, and securement of employment in STEM (National Academies of Sciences, Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce 2019 and National Academy of Sciences 2011). A variety

of factors are reported to contribute to one's success in STEM, including summer programs, research experience, career exposure, adjustment to the academic environment, a sense of belonging, academic support, mentoring and again self-efficacy (National Academy of Sciences 2011). Of these factors, self-efficacy is commonly found as both a contributing factor, as well as a measurement of STEM success.

Self-efficacy is described as how one perceives their ability to perform or achieve at a certain level, which can be general or task-specific (Wise and Trunnell 2001). Students' pursuit of specific majors or careers is dependent on their belief in their capabilities of being successful in a field of their interest (Lent, Brown, Sheu, and Schmidt 2005; Wang and Degol 2013). Thus, a high sense of self-efficacy has been shown to promote persistence in STEM majors (Aryee 2017; Hardin and Longhurst 2015). STEM self-efficacy can be heavily influenced by one's ability to identify as a capable scientist, which can be difficult given the common "weed out" culture of STEM on most campuses. This culture fosters a highly competitive academic atmosphere. Studies show underrepresented minorities, already experiencing psychological challenges, will experience disproportionate attrition, especially when ill-prepared (National Academy of Sciences 2011).

Black Women in STEM

Women are working to better establish their place in STEM. Still, female researchers are more likely to earn less, be cited less often, and receive less funding. Additionally, five decades of the infamous "Draw a Scientist" study, concluded that: (1) young children drew more women scientists (2) more female children drew women scientists than male children, and (3) with age, children begin to draw scientists as male (Terada 2019; Chambers 1983).While the gender disparities in STEM are often studied, the "Draw a Scientist" review offers a ray of hope for the atmosphere of STEM for women. In contrast to the gains in gender, Yong reports that about 79% of the drawings from the studies were white, but David Miller of Northwestern University points out that assigning race to a child's drawing is not as simple, and factors like coloring material must also be considered (Yong 2018). While this may be true, numerous research studies have demonstrated that stereotype threat and implicit bias influenced the perceptions that promote social barriers for certain groups within STEM (Steele and Aronson 1995; Greenwald and Krieger 2006; Dewsbury 2017).

Crenshaw makes the point that intersectionality, the intersection of multiple identities such as gender and race can contribute to one's oppression or privilege in a society, depending on the identities. For Black Women, the identity of the female gender along with the identity of the black race subjects the Black woman to two oppressive groups, where they'd receive "double discrimination" (Crenshaw 1989; Malcom, Hall, and Brown 1976). The data indicate that Black and Hispanic women are the two groups of women facing the most difficulty in terms of STEM self-efficacy and establishing their rightful place in STEM.

Black Women and white women college students express the same interest in STEM majors; however, Black Women are not well represented in STEM, likely due to retention of minorities in STEM (National Academy of Sciences 2011). Of awarded STEM bachelor's degrees, only 2.9% of degrees were awarded to Black Women (Indiana University-Purdue University Indianapolis School of Science 2019). Of awarded STEM doctorates, the National Science

Foundation (NSF) reported ~4.5% were awarded to Black Women (2018). As mentioned earlier, success in STEM is often measured by successful employment in STEM fields. An American Institutes for Research (AIR) analysis reports that 1 in 5 Black STEM PhDs will pursue a non-STEM career (2014). Of the Black Women with STEM PhDs, specifically, about 46% work in a government setting, 9% work in research and development, and 34% hold mid-and top-level management positions (Upton and Tanenbaum 2014). Collectively, these statistics suggest that Black Women are not well retained in STEM and of those that remain in STEM fields, they are more likely to work outside of research and development.

Black Women success in STEM

An additional phenomenon of success in STEM as it relates to retention is the idea of "survival of the fittest", in which the characteristics of a STEM student contribute to their success or failure in STEM. In turn, this "survival of the fittest" mindset also implies that the underrepresentation of black students is of their own doing, further contributing to racial stereotypes for black students in STEM (McGee 2017).

With highly competitive environments, "survival of the fittest" mindsets, and implicit and explicit racial biases, to name a few, it is not surprising that Black Women in STEM have a hard time finding a sense of belonging. A sense of belonging is a key factor contributing to STEM success. The environment and challenges of one's identity, two identities for Black Women, are associated with lower STEM self-efficacy and poor long-term performance (Settles, O'Connor, and Yap 2016; Ahlqvist, London, and Rosenthal 2013).

While there are quite a few negative factors working against Black Women in STEM, there are a few things that researchers identified as contributing to their retention in STEM. Representation, specifically of other Black Women in their field, is said to be a great factor in the success of Black Women in STEM. Studies report that Black Women in STEM who establish community with other Black Women in STEM role models, had an increased sense of belonging. The same was shown when these women recruit mentors in Black Men or allies who acknowledge and respect their identities (Indiana University-Purdue University Indianapolis School of Science 2019). At times, role models can become mentors. Mentorship is often identified as one of the keys to successful completion of graduate programs for Black Women, especially at predominantly white institutions (PWIs) (Cropps and Esters 2018; Patton and Harper 2003). As McGee (2017) carefully states: "the persistent bias, discrimination and other stereotypical challenges that may plague a Black Women in STEM's journey can lead to battle fatigue which often discourages women from pursuing faculty careers or remaining in STEM fields, altogether." Therefore, mentorship of Black Women in STEM fields can only be advantageous to this particular group of individuals.

What Is Mentoring?

Throughout literature the words "mentor" and "mentorship" have various definitions. For the purpose of this paper we chose to define mentorship as "a relationship in which a more experienced or more knowledgeable person helps to guide a less experienced or less knowledgeable person" (Farren Ph.D 2006). The mentor may be older or younger than the mentee, but must have a certain area of expertise. This relationship is characterized by mutual

trust and benevolence; and aims at promoting the development and progress of the mentee (Chaio 2009).

Mentoring can be either inperson or on-line. In person mentoring, whether one-to-one or in groups, seems to be most common in programs intended to either spark initial interest in STEM for young children or in programs aimed at supporting older youth through some transition point (e.g., applying to college as a STEM major). Online models tend to be used in programs that seek to build large numbers of STEM relationships or to provide access to a wide variety of role models and perspectives. Online formats are also popular when in-person relationships are not possible due to geographic distance or other factors such as individual disability (Foundation 2012). Both in-person and online formats demonstrated evidence of effectiveness, but these different program formats often differ in key ways related to their structure and the focus of their mentoring relationships.

Mentoring Roles, Types, and Models

There are two roles within the mentoring relationship - the mentor and the mentee. Throughout the literature the mentor is described as an advisor, counselor, confidant, advocate, cheerleader and listener (Inzer and Crawford 2005). The mentor should be confident, secure, sensitive to diversity, and a good communicator. The mentor's role includes using their own experience and insight, to: identify the goals of the mentee; provide advice and guidance, encourage the mentees career/personal development, and provide suggestions on activities and information that would benefit the mentee's growth; and recommend pursuits that will develop specific areas in the person's personal and professional advancement. The mentee is described as the individual receiving the mentoring and generally must know what he or she wants and shapes the overall agenda for the relationship (Inzer and Crawford 2005). The mentee must establish priority issues for action or support.

There are two broad types of mentoring relationships: formal and informal (Ragins and Cotton 1999). Formal mentoring relationships are set up by organizations or institutions and are not created organically. This model theoretically aims to pair a qualified and trained individual (mentor) with a person in need of guidance (mentee) (Arnesson and Albinsson 2017). Limitations of this model include incorrect pairing, lack of training for the mentor on how to mentor, and lack of interest from either individual to mentor or be mentored (Straus, Johnson, Marquez, and Feldman 2013). Informal mentoring occurs without the use of structured recruitment, mentor training and matching services. Informal mentoring arrangements are usually done outside of a formal structure and usually develop organically. This model allows for both individuals to naturally form a relationship, instead of being assigned (Singh, Bains, and Vinnicombe 2002).

We know from practice and research that there are six models of mentoring: one-on-one, group, peer, distance/online, reverse, and speed (Buell 2004). One-on-One mentoring is the most traditional of all the types of mentoring (Thompson, Hansen, and Reinhart 1996). Only the mentor and mentee are involved in this type of mentoring, and it is usually a more-experienced individual paired with a less-experienced or much younger mentee. Group mentoring involves one or several mentors working with a group of mentees. Schools and youth programs often apply this model because there may not be enough time or resources to have one mentor for each

participant. Peer mentoring utilizes participants with the same role or department or have shared or similar experiences in their professional or personal lives (Karcher 2005). These peers pair up to offer support for each other. This can be a group or a one-on-one mentoring relationship. Reverse mentoring uses a flipped model from the traditional model (Murphy 2012).

That is, instead of a senior professional mentoring a more junior employee, the junior employee mentors a more senior professional. This relationship is usually for the younger or more junior professional to teach the skills or a new application or technology to the more senior one. Speed mentoring is a play on speed dating and usually occurs as part of a corporate event or conference (Cook, Bahn, and Menaker 2010). The mentee has a series of one-on-one conversations with a set of different mentors and usually moves from one mentor to the next after a brief meeting. The expectation is that the mentee should come prepared with questions for advice from the senior level professionals. Distance or e-mentoring uses online software or even email to expand the mentorship relation from face-to -face to virtual. For the purpose of this article we will focus on the impact of e-mentoring, specifically as it relates to Black Women and their success in STEM fields to serve as a potential mentoring tool during the COVID-19 pandemic.

E- Mentoring

Electronic mentoring, or e-mentoring, is defined as "a computer mediated, mutually beneficial relationship between a mentor and a mentee that provides learning, advising, encouraging, promoting, and modeling, that is often boundaryless, egalitarian, and qualitatively different than traditional face-to-face mentoring" (Bierema and Merriam 2002). Boyle-Single and Muller (2001) described e-mentoring as a computer-mediated relationship between an established professional (mentor) and junior individual (mentee) to increase the mentee's likelihood for success. Furthermore, they defined structured e-mentoring as a formalized program format that provides mentor training and outcome evaluation (Boyle-Single and Muller 2001).

E-mentoring created unparalleled opportunities for mentoring, as it provides several advantages over traditional mentoring. These include increased flexibility, geographical location between mentor and mentee is inconsequential; and management and coordination of mentoring interactions is easier without reliance on travel or meetings (Bierema and Hill 2005). As such, a variety of technical mediums can be used to facilitate e-mentoring relationships including: e-mail, electronic mailing lists, chat groups, intranets, and computer conferencing (Bierema and Hill 2005). E-mentoring also reduces barriers resulting from instant first impressions, based on physical appearance, thereby enabling mentors and mentees to focus on commonalities that encourage deep connections (Ensher and Murphy 1997). E-mentoring uniquely promotes mentoring relationships as it broadens the pool of available mentors by engaging a wider range of professionals (e.g., including physically disabled persons, corporate executives) and appealing to socially withdrawn potential mentees (Scealy, Phillips, and Stevenson 2002). Finally, e-mentoring provides a convenient way to supervise and monitor mentoring relationships through a written record provides, thereby providing a creating an archive of data to use for evaluation of mentoring processes and outcomes.

For all of these reasons, E-mentoring is thought to be more inclusive of marginalized groups [including people of color, low-income students, and women] than traditional mentoring as it crosses boundaries of race, class, and gender (Harris 1996; O'Neill, Wagner, and Gomez 1996).

Thus, e-mentoring provides mentorship opportunities for minorities and women who might otherwise have difficulty finding a mentor (Bierema and Hill 2005).

Impact of COVID-19 on E-mentoring

The novel coronavirus, COVID-19, pandemic challenges traditional mentoring methods as it demands flexibility and shifting priorities as students face ongoing uncertainty regarding curricular requirements. Women and communities of color, in particular, have been disproportionately negatively impacted by the COVID-19 pandemic on many different levels, including in the workplace. According to the Inside Higher Ed article, STEM Equity and Inclusion (Un)Interrupted, the pandemic will particularly negatively impact the careers of women of color in STEM and failure to respond could jeopardize years of slow progress toward faculty equity and inclusion (Goodwin and Mitchneck 2020). Understanding how the pandemic will differentially impact women of color in STEM, specifically Black women, is key to deliver equitable and inclusive solutions in the wake of the global health crisis.

To better understand systemic inequities in STEM, amplified by the COVID-19 pandemic, the National Academies of Science, Engineering, and Medicine (NASEM) commissioned a fast-track study focused on early indicators of the potential impact of the COVID-19 pandemic on the careers of women in STEM. Preliminary results of this study will be shared via a series of public webinars this Fall. In the third of five sessions, authors found that ensuring equity for women in STEM during COVID-19 creates equity for all minoritized identities as it relates to intersectional relationships within that said group (National Academies of Sciences, Investigating the Potential Impact of COVID-19 on the Careers of Women in Academic Science, Engineering, and Medicine 2020).

As such, the short- and long-term impacts of the COVID-19 pandemic on e-mentoring of Black Women in STEM are not yet known. Some key considerations that contribute to significant underrepresentation and disproportionate hardship include: increased negative impact of online learning environments as a result of contrapower incivility and harassment, hidden labor performed by women when it comes to mentoring students, and increased household labor (childcare, housework, and eldercare) (Goodwin and Mitchneck 2020). Additional considerations include challenges to the digital delivery format that may impact accessibility, varying geographically; devices shared among multiple members of the family; and multiple timing options to increase participation in online mentoring activities.

Mentoring of Black Women in STEM

Black Women remain underrepresented in science, technology, engineering, and mathematics (STEM) fields, as only 2% of practicing scientists and engineers are Black Women (NSB 2018). Their severe underrepresentation is linked to a myriad of issues Black Women face throughout the STEM career pipeline, with inadequate access to mentorship being one of the most prominent (Jefferson 2019). For example, women of color are disproportionately denied access to mentoring in academia due to majority group males traditionally dominating the academy (Crawford 2015). Furthermore, mentoring relationships are described as a counterspace, or a "safe space" that are occupied by members of non-traditional groups including women and racially/ethnically underrepresented groups (Ong, Smith, and Ko 2017).

Social support systems consisting of family, teachers, peers, and minority networks are critical in STEM achievement and the development of STEM identity and interest among Black Women and girls (Rice and Alfred 2014; Tate 2005). Mentorship at the graduate level, among Black Women in STEM has been shown to be a particularly effective form of positive institutional support (Borum and Walker 2012). While the benefits of peer mentorship have been widely researched, few studies have focused on the advantages of virtual mentorship programs, inclusive of training for mentors.

Impact of Mentoring on Black Women's Success in STEM

Race-matched connections validate, affirm, and increase the success of black doctoral students, contributing to their completion of their programs (Barker 2011). A 2010 study by the Bayer Corporation found, that of the Black men and women surveyed, 62% of the men and 71% of the women reported lack of mentors as a significant barrier they faced while pursuing pre-college STEM studies. Additionally, 45% of the Black women respondents reported the lack of mentors as a significant barrier they faced in college or graduate school while attempting to pursue careers in STEM (Bayer Corporation 2010).

Additional studies and frameworks, such as Felder and Baker's 2013 interest convergence advising framework, found doctoral degree completion Black students was highly dependent on successful advising or mentoring relationships that supported the students' academic interests. The researchers recommend the use of culturally inclusive advisements as a means to maximize student success and degree completion (2013). Altogether these statistics demonstrate the importance of mentoring, especially for African American women hoping to pursue STEM studies and careers.

Examples of Current E-mentoring STEM spaces for Black Women

We discussed the dynamics of mentoring, specifically E-mentoring, and its benefits on Black Women in STEM. Although there is no definitive ending to this COVID-19 pandemic, online STEM spaces have evolved and have provided more opportunities to cater to students. The following examples include current e-mentoring STEM spaces or overall supportive virtual communities that can benefit Black Women in STEM:

1. **The National Center for Faculty Development and Diversity (NCFDD)** is a virtual career and professional development platform offering training and mentoring for graduate students, postdocs, and faculty members striving for tenure-track positions. Online resources provided include, but are not limited to: professional development webinars, a dissertation success program, online courses about navigating the job market, as well as, webinars and courses regarding writing papers, getting funded, and preparing a tenure file. More information can be found at: facultydiversity.org.
2. **CariScholar** is a virtual mentorship network catering to students of Caribbean descent. This group aims to connect Caribbean students with individuals in their field of study to promote Caribbean-based mentorship amongst students and mentors. More information about this network can be found at: carischolar.com.
3. **Mentorship for Underrepresented STEM Enthusiasts (M.U.S.E.)** is an online resource for underrepresented students in STEM. They aim to provide representation across STEM fields, clear pathways to higher education, all while providing 1:1 mentorship for high school students, college students, and early career graduate students. M.U.S.E. can be found: www.instagram.com/musementorship.

4. **Building Relationships to Diversify Graduate Education (BRDGE) Alliance** is a new mentorship program aiming to develop undergraduate students at Historically black colleges and universities by pairing the undergraduate student with black graduate students at research institutions. While it will normally operate face-to-face, during the COVID-19 pandemic, this program will be virtual. Learn more at: brdgealliance.org.
5. **VanguardSTEM** is one of the oldest online platforms for WOC and non-binary people of color (POC) across various STEM disciplines. You can find them on Twitter and Instagram promoting original content as it relates to WOC in STEM, highlighting WOC in STEM, and doing what it takes to be an overall safe space for all of the identities of the WOC and non-binary POC in STEM who wish to join and engage in their community. Find information about them at: www.vanguardstem.com.
6. **Black Girls Guide to Grad School** is an online platform offering support to black girls in graduate school. They offer various services from free personal statement revisions to tips for graduate school. It is a growing platform that serves as a space for community building and connecting. There is limited 1:1 mentoring; however, the mentorship initiative is expanding. More information can be found at: malikagrayson.com/bgggs.
7. **STEMNoire** is the first research conference and wellness retreat for Black Women in STEM. While the retreat was postponed due to COVID-19 pandemic, it has become an online community for Black Women in STEM. A version of the wellness retreat was modified and delivered as "Black Women in STEM Week," which was found across online platforms, such as instagram and twitter. Their "Wellness Wednesday" online discussions cover a variety of topics that relate to Black Women in STEM. Find them at: stemnoire.org.

Conclusion

During the onset of the COVID-19 pandemic, we saw numerous disruptions in traditional methods of STEM professional engagement, causing society to reevaluate some of the traditional methods of STEM networking and career development; including mentoring. E-mentoring, though a well-studied practice, emerged as a sustainable mentoring approach as mandated isolations and social distancing requirements saw the disappearance of previous in person gatherings. E-mentoring provides several advantages over traditional mentoring, including: increased flexibility and management and coordination of mentoring interactions is easier without reliance on travel or meetings (Bierema and Hill 2005).

In addition, COVID-19 related professional disruptions had an even larger impacts on already marginalized communities, particularly Black Women. Black Women in the STEM workforce make up only 2.4% and 2% of science and engineering jobs, respectively, though they make up 6.4% of the total population. For Black Women in STEM, one variable to their persistence and success is mentoring. Mentoring has long been understood as a beneficial component of academic and professional development. It is consistently linked to academic success (e.g. increased GPA), as well as increases in self-efficacy, integration into the community, retention, career goals, intention to persist and much more. Access to individuals who look like you and have similar experiences has been linked to successful mentorship relationships, especially for Black Women (Ong, Smith, and Ko 2017).

Overall, research on mentoring, and particularly mentoring of Black Women, consistently points to the value of such relationships in professional achievement and persistence. Understanding the

strategies and barriers to establishing an online mentoring community for Black Women has the potential to advance the retention of Black Women in STEM by providing tools and insight to dismantle traditional mentoring programs and allow for strategies that specifically target Black Women.

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