AJHSE Vol: 2 (2): 89-99, 2021
DOI: 10.52417/ajhse.v2i2.162
Accepted Date: Sept. 30, 2021

www.ajhse.org

African Journal of Health, Safety and Environment
An official publication of the
Applied Environmental Bioscience and Public Health Research Group
University of Benin, Benin City, Nigeria
Open Access | Bi-annual | Peer-reviewed | International
ISSN (Online): 2695-1819 | ISSN (Print): 2695-2386

RESEARCH ARTICLE **AJHSE-OWSD-09**

INITIATIVES AND ROLE OF WOMEN SCIENTIST FORUMS WITH MENTORSHIP OPPORTUNITIES IN STEM

[*1]Konyeha, S., [2]Agwam, G. I., [3]Musa, E., [4]Ngonadi, I. V. & [5]Afehomo, A. C.

*[*1,2] Department of Computer Science, University of Benin, Benin City, Nigeria*
[3]Rubber Research Institute of Nigeria, Iyanomo, Benin City, Nigeria
[4]Petroleum Training Institute, Warri, Nigeria
[5]Department of Educational Management, University of Benin, Benin City, Nigeria

***Corresponding Author's E-mail:** susan.konyeha@gmail.com*

ABSTRACT

Women scientists are strategically positioned to drive the current initiatives for achieving targeted sustainable development goals (SDGs). Many women are celebrated today, who have made significant contributions in Science, Technology, Engineering and Mathematics (STEM), despite hurdles they have been faced with in their science careers. Engaging in normal scientific collaborations was difficult for some of them and simply impossible for others. They were not encouraged by the predominantly male environments of university and business worlds, barred from the communities in which male scientists met and conversed, these women in science struggled against discrimination based on gender. While many of these women have been nearly lost to history in a changing world, some achieved such pinnacles as the Nobel Prize by surmounting these hurdles. This paper investigates factors that inhibit women in science. To this end, a survey design based on random sampling technique using a questionnaire instrument was designed, to retrieve information from individuals engaged in science careers. The study population involved one hundred and fourteen post-graduate science students of the University of Benin. Data was collected and analyzed using SPSS 20.0 for descriptive and inferential statistics. The result revealed that females view mentorship as a very important factor towards their career progression in STEM, but 29% lacked mentors. 73% of the women were not aware of women scientist forums with mentorship opportunities. They were faced with the barrier of funding, lack of mentors and personally encountered gender bias amongst other barriers. From our result, it is evident that the role of mentors to mentees and women scientist initiatives alongside forums with mentoring activities, cooperation, networking and collaborative groups is needed to increase the participation of women and girls in STEM. It is recommended that mentoring forums and strategies should be adopted in schools and organizations to encourage girls and women in science.

Keywords: *SDGs, STEM, barriers, women scientist forums, mentorship roles and opportunities, model*

INTRODUCTION

The role of women in science can never be overemphasized. Seeking to achieve a balanced participation of men and women in science and technology is a valid enterprise not only on moral and social grounds but also, and especially, because of the benefits which would accrue to the scientific and technical world. The introduction of diverse points of view and different priorities and styles of working as well as the input of women's skills would contribute a great deal to science. Moreover, in this way the science and technology sectors would be better adapted to social needs and would more closely reflect the interests of all members of society.

The gender disparity in STEM is a multifactorial issue that includes social, cultural and institutional factors that cannot be ignored or overlooked. Brilliant girls and women might be interested in STEM but choose not to pursue degrees or careers in these fields because of the various obstacles they may face. This is a great loss to the society, ultimately. In (Farah *et al.,* 2020), a multi-center electronic cross-sectional survey was conducted across countries to profile female scientists and to identify the challenges that they experience throughout their career and the coping mechanisms that they utilize. The stress of reduced chance of finding and keeping a job as a woman age is also a problem in STEM (Quinn and Smith, 2018).

Gender bias is common and can result in barriers for women to be promoted, credited for their achievements, nominated for leadership positions or viewed as leaders (Hamilton *et al.,* 2018). There is lower representation of female scientists in STEM fields which translates into fewer female role models for girls and limited mentoring opportunities (Zakham and Jaton, 2019). Women are still under-represented in STEM fields. The gender imbalance is especially true among those who pursue higher education and advance in their research careers (Ley and Hamilton, 2008).

However, Mentoring is a character strength and it is often absent in academia due to fierce competition and lack of a mentoring culture. (Madsen and Andrade, 2018), proposed that training and development, and thus also mentoring, should address unconscious gender bias at the workplace. Women scientist forums should therefore consider mentorship opportunities as a crucial means to promote more participation of women in STEM for scientific and technological excellence.

As a solution to tackle the issue of gender imbalances in STEM, mentoring has been recognized as a valuable development strategy and an affirmative action tool that can be used to support and promote women and groups that have been viewed as previously disadvantaged (Mcilongo and Strydom, 2021) UNESCO and other women scientist forums with mentoring opportunities aims to support and promote networks of women scientists in various scientific domains and regions. Some women scientist forums with mentorship opportunities are:

African Women in Mathematics Association (AWMA), African Association of Women in Geosciences and International Network of Women Engineers and Scientists (INWES). Also, UNESCO's Natural Sciences Sector is also working with the Organization for Women in Science for the Developing World (OWSD), a network of more than 4,000 members throughout the world, created to provide research training, career development and networking opportunities for women scientists at different stages of their careers, as well as give to girls and women in science the opportunity to meet role models and mentors.

GENDER AND WOMEN'S EMPOWERMENT (GEWE)

Bring together higher education and research institutions, and encouraging international and regional cooperation to enhance institutional capacities through knowledge sharing and collaborative work on these topics.

UNESCO AND THE L'ORÉAL CORPORATE FOUNDATION

Is a pioneering programme for the promotion of women in science which seeks to recognize women researchers who, through the scope of their work, have contributed to overcoming today's global challenges.

THE ELSEVIER FOUNDATION AWARDS FOR EARLY-CAREER WOMEN SCIENTISTS IN THE DEVELOPING WORLD KENYA

An initiative empowering girl through mentoring in STEM for informed career choices strengthening networks of women scientists all over the world Increasing the participation and representation of women in physics at the Abdus Salam International Centre for Theoretical Physics (ICTP) to support a mentoring pair, presented in an easy-to-use format. Visit www.ncwit.org/resources for more related NCWIT resources.

MILLION WOMEN MENTORS (MWM)

The Million Women Mentors (MWM) is an initiative, with the goal of using mentorship to educate and empower women and girls to pursue careers in STEM. The initiative was created by STEM connector to match women and girls aspiring to pursue STEM degrees and careers with successful mentors who have already reaped success in their chosen STEM fields. (Beard, 2014)

FABFEM PROJECT

The FabFems Project is an international database of women who are inspiring role models for young women. It is free and accessible to young women, parents, girl-serving STEM programs, and other organizations working to increase career awareness and interest in STEM.

500 WOMEN SCIENTISTS

500 Women Scientists' Request a Woman Scientist platform connects an extensive multidisciplinary network of vetted women in science with anyone who needs to consult a scientist for a news story, invite a keynote speaker or panelist for a conference or workshop, find a woman scientist to collaborate on a project, or serve as a subject matter expert in any capacity.

ACE MENTOR PROGRAM: ARCHITECTURE, CONSTRUCTION, ENGINEERING

The ACE Mentor Program of America, Inc. not only engages sponsors and volunteer mentors to expose students to real-world opportunities, it financially supports each student's continued success through scholarships and grants. The ACE program helps to mentor high school students and inspires them to pursue careers in design and construction. Also, Mentoring-in-a-Box: Technical Women at Work is a resource from the National Center for

Women & Information Technology (NCWIT). This resource offers activities, resources, and tools to support a mentoring pair, presented in an easy-to-use format.

Other mentoring groups and organizations are:

- WAAW Foundation's STEM strategy that underlines how the use of computer science, technology and programming can be used to solve the energy and clean water crisis occurring in Africa through the use of an integrated inquiry-based learning experience. They are able to give girls an opportunity to seek STEM training while also introducing them to technologies that use available resources to solve massive issues in their own local communities.
- IEEE Women in Engineering (WIE) is one of the largest international professional organizations dedicated to promoting women engineers and scientists, and inspiring girls around the world to follow their academic interests in a career in engineering

NATIONAL MENTORING PARTNERSHIP (MENTOR)

MENTOR's mission is to fuel the quality and quantity of mentoring relationships for America's young people and to close the mentoring gap, sharing knowledge among mentoring programs, and works to drive increased investment to sustain and grow mentoring programs nationwide.

SCIGIRLS ROLE MODEL STRATEGIES

SciGirls provides a national PBS Kids series with the mission of changing how millions of girls ages 8-13 think about STEM, a safe, social networking site for kids on PBS and research-based activities, professional development and support for educators nationwide. SciGirls Role Model Strategies: Encouraging Girls to Consider STEM Careers offers basic training for role models, introducing them to best practices for their volunteer efforts.

TECHBRIDGE

Techbridge offers a downloadable resource for effective outreach by role models and corporations. Techbridge also offers a new online training for role models.

WOMEN@ENERGY

Women@Energy showcases talented and dedicated employees at the Department of Energy who are helping change the world. View profiles of women across the country, sharing what inspired them to work in STEM, as well as ideas for engaging underrepresented groups in STEM.

WOMEN@NASA

TheWomen@NASA contains a collection of videos and essays showcasing women who work across a variety of departments at NASA. The site contains resources and stories to inspire girls in STEM, information for K-12 educators, and serves as a hub for women and outreach at NASA. Having understudied all these STEM initiatives, we can boldly say that participation and great mentoring is the key for the next generation of scientists. Despite the

existence and achievements of these STEM mentorship groups, great obstacles are still been faced by women in STEM careers. Honest conversations about these issues are necessary for the progress of equal opportunity. According to Olivia Warfield of *DiversityInc Best Practices*, there are five main barriers women face in the STEM workforce (Olivia, 2018), they are:

DOUBLE COMPETENCE

Women often feel great pressure to prove their professional worth repeatedly. One women (a statistician) surveyed by Joan C. Williams reported, "People just assume you're not going to be able to cut it." This feeling has been reported in both professional workplaces and university settings. According to the study "Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering", multiple highly-qualified women in science report perceiving ongoing questioning about their ability and overall commitment to their respective disciplines. This feeling reportedly intensifies as women move up a career ladder into higher-level positions.

MISUNDERSTOOD MOTHERHOOD

Controversy and taboo surrounding motherhood follow women in many fields and the STEM fields are no exception. When a woman chooses to have a both a family and a career, she is questioned about her commitment to her career; it might even be assumed that she will permanently depart. Decisions involving parenthood is highly personal yet still somehow follows women into the workplace. Some women report feeling as though they are viewed as engaging with their work as a hobby and not as a lifelong calling or profession due to their potential or current motherhood. Maternity concerns tend to branch out into other barriers for women as well including income inequality and feeling a sense of stereotype threat. The special report "Retaining Women in STEM Careers: Graduate Students as the Building Blocks of Change" states that women with children are 28% less likely than those without to be placed in tenure-track positions.

LACK OF MENTORSHIP

Professional mentorships are vitally important in fields where the odds are "stacked against" rising individuals. Women jump multiple hurdles in STEM-related careers and having the advice of a woman who has already "been there, done that" can vastly improve the ability of women new to or rising up within their fields to stay the course and see that success is possible. Multiple reports state a lack of mentorship as an issue for women in STEM fields. Having a mentor can improve career opportunities and provide best practices for navigating career paths. Both formal and informal mentorships create advantageous partnerships for women; this can be difficult when there are so few women in these fields and in some cases, one woman might be the only one in her workplace or department. Mentors can actively address situations that might not be inherently easy for newcomers like workplace politics, negotiations (for salary or promotion), and overall life-balancing mechanisms.

STEREOTYPE THREAT AND IMPLICIT BIAS

Women are often on the receiving end of stereotype threat and multiple subtle but implicit biases. Stereotype threat describes a situation in which a negative preconceived stereotype can affect performance or even the willingness to attempt an activity at all. The problem of too few women in STEM fields could self-perpetuate given this stereotype threat where women are hesitant to enter and those who have entered such fields are dealing with the negativities and biases that accompany their entry. Women in minority-groups are even doubly subjected to variations of bias on a broad spectrum of discriminatory behavior. Biases come in a variety of packaging and some are simply so subtle that even highly-educated, informed individuals can be subject to their presence. Harvard's Implicit Association Tests can help people identify and decode implicit biases they have of which they might be unaware in order to establish informed dialogue.

INCOME INEQUALITY

A study among Canadian engineers discovered that women engineers were earning 16% less on average than males performing equal positions. It's also reported that the income gap widens between genders over time worked in the field. The report "Retaining Women in STEM Careers" details a report where STEM employers were asked to review identical resumes, one female and the other male, and repeatedly gave the female resume a lower starting salary. Income inequality is demotivating and degrading to women who already must wrestle with other inherent biases. Bridging the income inequality gap will amplify women's progress in the struggle for equal treatment. STEM organizations should implement hiring standards that ensure an equal playing field in the application and interview processes.

- Women have spoken: they are experiencing documentable gender bias. In the continuous effort to encourage more young women and girls into STEM fields, there is much work to be done. Throughout all education levels, intelligence should not be spoken of as a fixed attribute that cannot alter with aging and education. Viewing intelligence as absolute can discourage young girls when they encounter difficulties in their education. Perseverance and encouragement is vital for all young minds to grow in STEM education.
- Everyone should examine their own inherent biases to open dialogue about implicit bias. Women should be proactively recruited into STEM fields and be provided opportunities for STEM education where they can study in an equitable setting with other women. This could take place in "Women in STEM" clubs or organizationally-sponsored events. Institutions should review their government-backed discrimination and diversity policies to ensure thorough, genuine compliance. With concentrated effort, women will able to comfortably pursue fulfilling careers in the STEM fields without hesitation.

AIM AND OBJECTIVES

The Aim of this paper is to investigate the obstacles women face in STEM and identify the role of Women Scientist Forums with Mentorship Opportunities in STEM.

The objectives are:

- To identify women Scientist forum with mentorship opportunities and their initiatives in STEM;
- To investigate factors that inhibit individuals engaged in science careers.

Hypotheses

H_0: There is no significant barriers between the female mentorship and male mentorship working in the Sciences

H_1: There is no significant difference in career progression between the female and male in STEM

METHODOLOGY

The study was conducted among Postgraduate students of the University of Benin, Benin City, Nigeria. The university is located in Ovia North East Local Government Area of Edo State. Edo state is in the South-South Nigeria. It is located between latitudes 6°20.022′N and longitudes 5°36.009′E. The university has two campuses: Ugbowo campus and Ekehuan campus. This study was carried out in the Ugbowo campus

STUDY DESIGN

The study adopted the cross - sectional research design which allows the research to be carried out in a natural setting without the control and manipulation of the variables by the researcher. The design analyses data collected from a population or a representation subset at a specific point in time. The advantage with this design is that it allows statistical inferences to a broader population so that results can be extrapolated. Individuals in Sciences comprising of Postgraduate diploma (PGD) and Masters students of some departments in University of Benin form the population of the study.

SAMPLING TECHNIQUES

A total of five departments (Postgraduate students) in UNIBEN were involved in the study. Using the simple random sampling technique (balloting) five (5) Departments were selected. One hundred and fourteen (114) students in the selected departments were sampled randomly. The selected departments are presented in Table 1:

Table 1: List of selected departments and Postgraduate students sampled.

S/N	Departments	No of respondents
1.	Computer Science	24
2.	Electrical Engineering	30
3.	Physics	20
4.	Mathematics	20
5.	Chemistry	20

DATA COLLECTION AND ANALYSIS

Data collection was done through the administration of a structured questionnaire to Postgraduate students of the selected Departments during their postgraduate seminar. The questionnaires were screened for completeness by the researcher, coded and entered into the IBM SPSS statistics 20.0 software for analysis. The study population involved a random sample of One hundred and fourteen post-graduate science students of the University of Benin comprising of eighty females and thirty-four males.

Table 1: Demographic characteristics of study population

Gender	*Frequency*
Male	34
Female	80
Total	114

Table 2: Educational status of respondents

Level	**Frequency**	**Percentage**
Postgraduate Diploma students	60	52.63
Masters Students	54	47.37
Total	114	100

Descriptive statistics, simple percentages and chi-square were utilized to investigate factors that inhibit Males and Females in Science, Technology, Engineering and Mathematics (STEM).

Table 3: Barriers faced by individuals working in the sciences

Factors	**Females**	**Males**
Funding	88% (1)	93% (1)
Balancing life and career	77% (2)	67% (4)
Scarcity of job openings	67% (4)	69% (3)
Gender biases	62% (5)	21% (11)
Having/raising children	62% (5)	43% (5)
Child care support	50% (7)	29% (9)
Low pay	44% (8)	42% (6)
Need for networking between scientific forums	30% (10)	36% (8)
Lack of role models	29% (11)	14% (12)
Elder care	22% (12)	12% (13)
Access to mentors	41% (9)	24% (10)
Readiness to mentor	29% (11)	37% (7)
Resistance to mentorship	53% (6)	24% (10)
Awareness to mentorship opportunities	73% (3)	82% (2)

RESULTS AND DISCUSSION

The results of the survey have shown that a total of 114 respondents were involved in the study (Table 1). This comprises of thirty-four (34) males and Eighty (80) females. All the respondents were Postgraduate students (Table 2). Their responses were ranked and the ranks were assigned to values in descending order. The Largest value orders the data in descending order (largest to smallest), and assigns the largest value the rank of 1. 88% of the females in science expressed lack of funding as a barrier, compared to 99% of their male counterpart. 41% of the females lacked access to mentors while 24% of the males also did not have access to mentors. 77% of the females had problems in balancing life and career while 67% males had same problem. The awareness of respondents to the barriers faced by individuals in the sciences is high. Specifically, the response showed that (73%) of the females were unaware of mentorship opportunities while 82% of the males were also not aware of mentorship opportunities. Data collected were analyzed using descriptive and inferential statistics.

We computed the value of the chi-square statistic using the formula:

$$X^2 = \sum_{i=1}^{n}\sum_{j=1}^{m}\frac{(o_{ij} - e_{ij})^2}{e_{ij}}$$

Where *oij* is the observed frequency for the row *i* and column *j*, *eij* is the expected frequency for the row *i* and column *j*. The test for difference in the career progression for male and female individuals working in the sciences using Chi-Square test assuming that there is no significant difference in the career progression for male and female individuals working in the sciences using Chi-Square test (null hypothesis) tested with a p – value of 0.05. Our result is presented in table 4.

Table 4: Difference in Career Progression for Male and Female (Chi – Square Test)

Calculated Value	Critical Value	d.f	P – valiue
27.71431	16.92	9	0.05

The null hypothesis is rejected which indicates that there is no significant difference in career progression for male and female individuals working in the sciences. This means that the alternative hypothesis is accepted which indicate that there is a significant difference in the career progression for female individuals working in the sciences. Chi-Square was used to test for association between the barriers faced by male and female working in the sciences. We assumed that females do not face significant barriers to mentorship compared to their male counterpart (null hypothesis). This tested with a p – value of 0.05. The result is presented in table 5.

Table 5: barrier to mentorship

Calculated Value	Critical Value	d.f	P – Value
14.63712469	7.82	3	0.05

The null hypothesis H_o was rejected which indicated that females working in the sciences do not face significant barriers to mentorship compared to their male counterpart. This means that we accept the alternative hypothesis which indicate that females working in the sciences do face significant barriers to mentorship compared to their male counterpart.

CONCLUSION

It is evident that the role of mentors to mentees and women scientist initiatives alongside forums with mentoring activities is very important. Also, cooperation, networking and collaborative groups is needed to increase the participation of women and girls in STEM. In this study, the obstacles individuals particularly women face in Science, Technology Engineering and Mathematics (STEM) has been identified, participation in women scientist forums with mentorship opportunities is been encouraged as means of overcoming some of those challenges.

REFERENCES

Beard, K. (2014) *Million Women Mentors Launched to Fill the Gap of Women in STEM Fields* USnews (https://www.usnews.com/news/stem-solutions/articles/2014/01/09/million-women-mentors-launched-to-fill-the-gap-of-women-in-stem-fields)

Farah, N. F., Phyllis, A. Y., Nancy, A. G. & Fathiah, Z. (2020) Challenges and coping strategies faced by female scientists—A multicentric cross sectional study. *PLoS One.* 15(9): e0238635. **DOI:** 10.1371/journal.pone.0238635 PMCID: PMC7505433

Gjerdingen, D, McGovern, P, Bekker, M, Lundberg, U. &Willemsen, T. (2001) *Women's Work Roles and Their Impact on Health, Well-Being, and Career*: Comparisons Between the United States, Sweden, and The Netherlands, Women & Health, 31:4, 120, 10.1300/J013v31n04_01

Hamilton, K. E, Tétreault, M. P, Lund, P. K. (2013). *Opportunities and challenges for women PhD investigators in gastrointestinal research. Gastroenterology*. **DOI:** 10.1053/j.gastro.2013.06.024

Ley, T. J, Hamilton, B. H. (2018). *Sociology*. The gender gap in NIH grant applications. Science. 322:1472–1474. **DOI:** 10.1126/science.1165878

Moss-Racusin, C. A, Dovidio, J. F, Brescoll, V. L, Graham, M. J, & Handelsman, J. (2012). *Science faculty's subtle gender biases favor male students.* Proceedings of the National Academy of Sciences of the United States of America. 2012;109(41):16474–16479. 10.1073/pnas.1211286109

Madsen, S., & Andrade, M. (2018) Uncounscious gender bias: Implications for women leadership Development *Journal leadership Studies.* 12(1) 62-67

Mcilongo, a. M. & Strydom K. (2021) The significance of mentorship in supporting the career advancement of women in the public sector. *Cell Press.* https://www.cell.com/heliyon/pdf/S2405-8440(21)01424-9.pdf

Pohlhaus J., Jiang, H. & Wagner, R. (2011) Sex differences in application, success, and funding rates for NIH extramural programs. *Academic Medicine* 86:759–767 **DOI:** 10.1097/ACM.0b013e31821836ff

Quinn, P. & Smith M. (2018). Gender, Work, and Health, Annals of Work Exposures and Health, 62(4) 389–392. **DOI:** 10.1093/annweh/wxy019

Warfield, O, Five barriers women faced in STEM Diversity Inc Best Practices retrieved July, 2021

Zakham, F. & Jaton, K. (2019). Supporting female scientists in Yemen. *Lancet.* 393 (10171): 526–527. **DOI:** 10.1016/S0140-6736(18)32088-9