

REVIEW OF CONTRIBUTIONS OF WOMEN IN TECHNOLOGY: SHAPING THE FUTURE

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ABSTRACT

In Nigeria young men are almost twice as likely to have a career in computer science and technology – related fields as women. According to the National Bureau of Statistics, women make up on average just 22% of the total number of Engineering and Technology university graduates each year (www.nigerianstat.gov.ng). The same source also affirms that women make-up roughly a fifth of the total number of people working in information and communication technology sector. However, it is not only about the numbers. It is about enriching and complementing your workforce with the diverse qualities and perspectives of women, research has shown that better and more useful tools are created when the developers of such tools fully represent the diversity of the societies we live in. This means that, to get fully functional and universally acceptable inventions, the opinion of women have to be taken into consideration. This paper shows the impact women will play in the future of technology while examining the challenges they face in their pursuit of academic and career excellence, it further presents irrefutable evidences of women who have affected the entire world with their inventions in time past and those who are making waves with their continuous innovative efforts at bringing technology to its peak at present.

KEYWORDS: Women in technology, Gender gap, Women career in stem

1. INTRODUCTION

The minds of many reasons that a woman's place is “only” in the home. They believe that a woman should be seen but never heard. It ruffles the sensibilities of such people when they see women making waves in the world around them. This has been the case in many places all over the world (Dina, 2017). For a long time, women in Nigeria and other parts of Africa have been a disadvantaged group when it comes to educational and career opportunities in the STEM (Science, Technology, Engineering and Mathematics) field. Most girls in schools were encouraged to take courses that were regarded easier and more adaptable to being a wife and a mother, while avoiding male-dominated areas such as engineering and technology. Nigeria, like many other African societies, is built on patriarchy, which encourages male dominance in all the major aspects of life. The dominance of the male gender is very much conspicuous in the Science, Technology, Engineering and Mathematics (STEM) fields of the Nigerian academia. Being a specialized field, given its complexity and thoroughness, the Sciences are mostly considered an area exclusive for men. According to Rabia Salihu Sa'id (2015), “Nigerian women make up only 17 percent of all science researchers in the country.” In another report by Adefunke Ekine and Negar Ashtari Abay (2013), it is estimated that “overall, women make up just under 35 percent of students in these science faculties.” Clearly, the Nigerian society is structured to make the Sciences unattractive to the female gender. According to Rabia (2015), “Some girls feel more comfortable choosing a shorter course in the arts or social sciences, so they can avoid the pressure of getting married while still studying.”

However, this is gradually changing. In Africa, we are experiencing the rise of women to prominent positions of power as is being experienced in Liberia, Mauritania and Ethiopia. In each of these countries positive changes have been observed since a more gender – equality based approach was adopted.

Just as the evidence suggests that a more gender inclusive political system may lead to better policies for women and girls (Chattopadhyay and Duflo, 2004), and integrating women into corporate boards may mean reaching new

consumers, not to mention higher profits (Joy, Harvey, Sriram, 2007), there is a case to be made for increasing women's presence in developing technology and innovation.

It seems like today's women are better positioned than ever before to rise to leadership roles in technology. Not only do companies have many kinds of support structures in place, such as women's networks and leadership development courses, but there are increasing numbers of women at the top who can serve as role models or inspiration.

Nevertheless, women are still a distinct minority in the technology workforce – and an even smaller proportion of corporate leadership. The numbers are appalling: women make up less than 25% of the STEM (Science-Technology-Engineering-Mathematics) workforce in the world. Data from the US National Science Foundation shows that between 2000 and 2014, the number of women graduating with a degree in computer science actually declined. (www.nsf.gov/nsb/sei/edTool/data/college-14.html)

A youth survey report issued by the National Bureau of Statistics, in Nigeria young men are almost twice as likely to have a career in computer science and technology-related fields as women. According to the National Bureau of Statistics, women make up on average just 22% of the total number of Engineering and Technology university graduates each year. Furthermore from the same source, women make-up roughly a fifth of the total number of people working in information and communication technology sector. (<https://wtec.org.ng/the-gender-gap/>)

Why does this under-representation of women matter? Research shows that diverse teams perform better. Individuals from different genders, races, backgrounds and experiences bring different perspectives that can lead to innovative solutions.

Despite the daunting challenges and the discouraging numbers; Women have made significant contributions to the development of new technologies, overcoming many barriers to study and work. In years past, women have been barred from colleges and universities, denied the opportunity to work in certain fields, and had their work obscured or stolen by male scientists. As a result, the history of technology is told as a story of great men. However, there were many women in times past who shaped the technology that we use daily along with others who continue to strive to improve the technology currently available to world and others strive in the field of technological education to build up a more female – inclusive technological world thereby inspiring women to go into technological careers.

2. CHALLENGES THAT WOMEN FACE IN THE PURSUIT OF A CAREER IN STEM

As women continue to try to make a path for themselves in the science and technology industry, many challenges beset their earnest strives. Some of the challenges these women face include:

Innovation as reflected in patents is still male dominated:

In the United States, proportion of patents including at least one woman inventor increased from 3.4 percent in 1977 to 18.8 percent in 2010, but under 8 percent of all patents have women as primary inventors (Milli, Williams-Baron, Meika, Xia, and Gault, 2016). Looking across the subset of commercialized patents, Hunt, Jean-Phillipe, Herman, and David, (2012) suggest that only 5.5 percent of holders are women. This is a global problem: across the world, women accounted for about 10 percent of patent authorships weighted by the number of names on each patent in 2013 (Sugimoto, Lariviere, Ni, Gingras, & Cronin, 2014).

Women inventors cluster around “traditional female roles”:

In the United States, above 50 percent of patents in the field of “chemistry: natural resins or derivatives” include a woman inventor, but women are usually the primary inventor in patent technologies associated with traditional female roles: the two top-ranked patent classes with women as the primary inventor are “travel goods and personal belongings” and “jewelry, symbolic insignia and ornaments” (Milli et al., 2016).

Overall education rates are not the source of the problem, but specific concentrations are still part of it:

Huyer (2015) finds that worldwide women represent 53 percent of bachelors and masters graduates and 43 percent of Ph.D graduates. In the United States, where women are almost as likely as men to have a science or engineering degree, Hunt et al. (2012) suggest only 7 percent of the gap in commercialized patents is accounted for by the lower

probability that a woman holds such a degree. The patenting gap largely exists because in contrast to men women with such degrees are scarcely more likely to hold a patent than women without such degrees. One factor behind this mismatch between the number of science and engineering degrees overall and patenting performance is the particular disciplines studied engineering is a patent-rich discipline but one that attracts comparatively few women. In 2010, women accounted for 58 percent of biological science degrees and 39 percent of physical science degrees in the United States, but only around 20 percent of engineering and computer science degrees (Milli et al., 2016). The United States sees one of the lowest shares of women among engineering graduates in the world significantly lower than many developing countries, and less than one half the proportion of Denmark, Poland, or Malaysia. But even these comparatively equal countries only see women making up a third or so of graduating classes in engineering (Huyer, 2015).

Women do not apply for public funding as often as men, and private funding for innovation also largely goes to men:

In the United States, women at particular career stages are less likely to apply for competitive grants for which they are eligible (Ovseiko, Alison, Laurel, Sue, 2016). Only three percent of venture capital funding in the United States went to businesses with a woman CEO between 2011 and 2013 (Milli et al., 2016).

3. WOMEN WHO CHANGED THE WORLD OF STEM IN NIGERIA AND ABROAD

In the era when women were not readily reckoned with as been important in the STEM field, a few women made their mark in the world of technology and some of their inventions have improved the quality of life for many people over the world. Also, amale-dominated space in the field obscures the reality that there are some women, although in the minority, who have excelled tremendously in the areas of STEM in Nigeria and world over. Some of these women are herein under-listed together with their achievements:

Grace Alele-Williams

The academic life of Professor Grace Alele-Williams defies the traditional thoughts about the place of women in the society. She symbolizes the excellence a woman could achieve, if given the opportunity. Professor Alele-Williams is a first at different levels of achievements. She is the first Nigerian female to earn a Ph.D. in Mathematics, the first female Professor of Mathematics, and the first female Vice Chancellor of a University in Nigeria. She received her university education at the University of Ibadan, the University of Vermont and University of Chicago, respectively. Finding herself in the “space age”, which symbolized the era of stiff competition between the two major powers (the United States and the Soviet Union) over scientific discoveries, Alele-Williams increasingly developed interest in Mathematics in the US. Professor Alele-Williams’ interest was further buoyed by her stint at the African Mathematics Program in Newton, Massachusetts, under the mentorship of MIT Professor Ted Martins.

Besides being a former Vice Chancellor, Alele-Williams has held different leadership positions in the development of Science education at local and international levels. She was Chairman, Curriculum Review Committee in 1973 and a member of the Governing Council of UNESCO Institute of Education. She held the position of Vice President of the World Organisation for Early Childhood Education and a Regional Vice President for Africa of the Third World Organization for Women in Science. Alele-Williams received the National Honor of the Order of the Niger in 1987 and was a member of the Vision 2010 Committee. (Wikipedia, May 2019)

Francisca Nneka Okeke

Professor Nneka Okeke is by all standards a distinguished scientist who has made tremendous contributions to her field – Physics. Professor Okeke gained international prominence after winning the highly respected L’Oreal-UNESCO Women in Science Award worth USD 100, 000 in 2013. The award was in recognition of her notable contributions to the understanding of daily variations of the Ion currents in the upper atmosphere. Presently a Professor at the Department of Physics and Astronomy in the University of Nigeria, Nsukka (UNN), Okeke was the first female Head of the Department and a former Dean of the Faculty of Physical Sciences in her university.

Born in an environment where female education was discouraged, Okeke was motivated to study Physics by her father, a Mathematician, whom she saw as a mentor. As a young girl, she was very inquisitive and asked intelligent questions about nature and objects around her. She was particularly interested in knowing the wonder behind airplanes and how they fly without falling on the earth. Professor Okeke is exceedingly passionate about the education and empowerment of women particularly in the Sciences. As HOD and Dean at UNN, she was instrumental to the employment of more

women in the faculty. From her mentorship of young women, one of her Ph.D products was a recipient of the AU-TWAS young scientist Award in 2010. Professor Okeke has successfully supervised 12 Ph.D and about 28 M.Sc. students. (Wikipedia, May 2019)

Deborah Ajakaiye

Professor Deborah EniloAjakaiye is Africa's first woman to be appointed a Professor of Physics in 1980. Ajakaiye completed her Ph.D in Geophysics at the Ahmadu Bello University (A.B.U.), and her Master and Bachelor's degrees at the University of Birmingham and University of Ibadan, respectively. She lectured at Ahmadu Bello University and later the University of Jos where she rose to the position of Dean in the Faculty of Natural Sciences. Her contributions to the field of Geophysics through her works on 'Geovisualization' has been significant in Nigeria's location of its abundant mineral resources.

Professor Ajakaiye has been recognized at local and international forums. She was awarded by the Nigerian Mining and Geosciences Society. She was also the first black African to be named a Fellow of the Geological Society of London. Professor Ajakaiye was one of the 50 Women of Distinction awarded by the First Lady, Dame Patience Goodluck Jonathan in 2010, in celebration of Nigeria's 50th independence anniversary. Ajakaiye is currently working with the NNPC on its drive for alternative crude oil reserves with the exploration of the inland sedimentary basins in other parts of Nigeria. (Wikipedia, June 2019)

Olabisi Ugbebor

Professor Olabisi Ugbebor is dubbed the "Queen of Mathematics" for her outstanding record in Mathematics. Professor Ugbebor studied at Queen's College, Lagos on G.B. Ollivant Scholarship for her West African School Certificate Course (WASC), and because of her brilliant academic performance the scholarship was specially extended for her to cover the Cambridge Higher School Certificate Course also at Queen's College, Lagos. Following her brilliant performance at the Higher School Certificate Course, the Federal Government of Nigeria awarded her a scholarship to study Mathematics at the University of Ibadan from 1969-1972, where she was the only female in a class of seven Mathematics majors.

She graduated from the University of Ibadan in 1972 with a Second Class Upper Honours degree in Mathematics. Again, on account of her outstanding academic brilliance, she was given a scholarship by the University of Ibadan to undertake Postgraduate studies at the University of London. She was awarded the Postgraduate Diploma in Statistics at the University College London in 1973 from the first university statistics department in the world. She then embarked on her Ph.D degree course in Mathematics in 1973 at the University of London, which she completed in 1976 at the age of 25. After obtaining her Ph.D degree in 1976, Professor Ugbebor returned to the University of Ibadan and joined the Department of Mathematics, where she rose to become a Professor, thus making history as the first woman to attain that position in the department at the University of Ibadan. At different occasions, she also served as the Acting Head, Department of Mathematics.

In 2014, Professor Ugbebor was elected the first President of Nigerian Women in Mathematics at the Inaugural Meeting of the Nigerian Women in Mathematics. Some of her products have recorded outstanding achievements in the discipline of Mathematics. These include Professor Steven Onah, the Head of National Mathematical Center and Professor Ayoola, a former Deputy Vice-Chancellor (Academics) at the University of Ibadan. (Wikipedia, June 2019)

Adenike Osofisan

Professor Adenike Oyinlola Osofisan is the first Nigerian female to hold a doctorate in Computer Science, and the first female Professor of Computer Science in Africa. In addition to her specialization in Computer Science, Osofisan also excelled in Business Administration as she received the best result in the 1993 MBA class of the University of Ibadan. As Head of the Department of Computer Science at the University of Ibadan, Osofisan began post-graduate programmes in the department and her tenure has recorded more staff with Ph.D degrees. Osofisan made history as the first woman to serve as President and Chairman of the Computer Professionals Registration Council of Nigeria between 2005 and 2009. Professor Osofisan was also the Pioneer President, Nigeria Women in Information Technology (IT). (Wikipedia, May 2019)

Chinedum Peace Babalola

Professor Chinedum Peace Babalola is the first female Professor of Pharmacy at the University of Ibadan. She is also the first female Pharmacist in Nigeria to be inducted as Fellow of Academy of Science (FAS). Babalola obtained all her degrees at the Obafemi Awolowo University (O.A.U.), with specialization in Pharmacokinetic Option in her doctorate. Professor Babalola is notable for her research that produced a novel High-performance liquid chromatography Method for the analysis of quinine in biometrics. This outstanding research led to the elucidation of the pharmacokinetics of quinine in Africans and formed the basis of dose optimization in malaria patents.

Professor Babalola is one of the scientists that produced the first pharmacogenetic study in healthy and sickle cell patients in Nigerians. Currently, the Dean of Faculty of Pharmacy University of Ibadan and Adjunct Professor in Genetic & Bioethics unit, IMRAT, College of Medicine University of Ibadan, Babalola is a Fellow of the African Academy of Sciences and the Nigerian Academy of Science. Professor Babalola's research earned her selection alongside Dr. Adeboye Adejare of the University of the Sciences in Pennsylvania for research on the interaction between compounds and small endogenous compounds as targets for drug action.

Hedy Lamarr: The world owes her a much greater debt. She is the co-inventor of frequency – hopping and spread spectrum; techniques that were used to shield military and other sensitive communications during World War II are now used in Wi-Fi and Bluetooth technologies. (Source: <http://www.ecpi.edu>).

Frances Spence and Kay McNulty Mauchly Antonelli: The work of Frances Spence and Kay McNulty Mauchly Antonelli also known as “The Human Computers” helped shape the outcome of World War II. They worked during an era where a computer was a person who calculated sums, and during the war, computers were mostly women. Performing these calculations by hand, or even simple machines, was too slow for a war that moved at the speed of flight, so they were chosen to help program the first electronic digital computer, known as ENIAC, in 1946. (Source: <http://www.ecpi.edu>).

Ellen Ochoa: She took women's technological innovations to the stars through her work with NASA. She developed optical inspection and image refinement methods for automated examinations of images from space. Ochoa became the first Latina to head NASA Johnson Space Center. (Source: <http://www.ecpi.edu>).

Katherine Johnson: Born in 1918, Katherine Johnson, graduated from university at 18. She was awarded the Presidential Medal of Freedom in 2015 for a lifetime of work as a pioneering physicist, mathematician and space scientist. She and her colleagues, Dorothy Vaughan and Mary Jackson did the calculations that guided NASA's 1962 Friendship 7 Mission. (Wikipedia, 2019)

Augusta Ada King: She is best known for writing the first computer algorithm during her collaboration with Charles Babbage on the Analytical Engine. (Wikipedia, 2019)

Radia Perlman: Radia Perlman disapproves when people call her The Mother of the Internet. But as an early computer scientist and student of MIT in the 60's she became an internet pioneer, developing the algorithm behind the Spanning Tree Protocol (STP), an innovation that made today's Internet possible. She also invented TRILL to correct limitations of STP. (Wikipedia, 2019)

Rear Admiral Grace Hopper: An American computer scientist, and a Rear Admiral in the US Navy, Grace Hopper invented the first programming language to use English words. She is seen as a key inventor of the language COBOL (an acronym for Common-Business-Oriented-Language) a widely used programming language. (Wikipedia, 2019)

4. PROGRAMMES BUILDING UP THE INTEREST OF GIRLS AND WOMEN IN THE STEM FIELD

Several organizations and individuals have taken the bull by the horns and are creating opportunities for women to get involved in the study of STEM programmes, and ultimately work and become experts in the field. In Nigeria, there are several initiatives that help to educate women and girls in areas of STEM such as coding and programming. These initiatives are geared towards one purpose; encouragement and empowerment of women and girls to participate in technology-related fields. There are various areas of focus, including getting girls interested in ICT-related education and careers, removing limitations and barriers culturally and socially, increasing the participation of women in STEM careers, and providing the required training and opportunities for women and girls to thrive in the STEM field.

Some of the organisations involved in this work include:

Women's Technology Empowerment Centre (W.TEC)

A pioneer organisation in this work is [Women's Technology Empowerment Centre \(W.TEC\)](https://wtec.org.ng/about-us/). W.TEC is a Nigerian non-governmental organization working for the economic and social empowerment of girls and women, using information and communication technologies (ICTs). W.TEC was one of the first organizations working in the gender and technology space in Nigeria. Since 2008, they have worked hard to educate the wider public about the importance of gender equality in technology through training, speaking at conferences, hosting public discussions, media interviews and presenting their results and alumnae. W.TEC's programmes comprise of technology literacy training, technology – based projects, mentoring and work placement. W.TEC also researches and publishes works examining pivotal issues related to how African women use technology, barriers preventing or limiting technology use, and strategies for more efficient technology use. Their objectives are for Nigerian women to develop financial independence by: training for ICT-specific jobs, like computer engineer, programmer, system analysts, hardware and network specialists, designers; developing technology skills that can be used for other ICT-reliant jobs or self-employment. We also want women to develop skills and confidence to use ICTs for activism, learning, awareness-raising and advocacy for a better quality of life. (<https://wtec.org.ng/about-us/>)

High-Tech Women – This an NGO that works with women and youths to empower them through ICT for research, entrepreneurial development, competitive advantages and wealth creation. With a vision to ensure that every woman and youth in Nigeria is ICT literate and can use it to create wealth, High-Tech Women carries out training a in technology for young people, in collaboration with schools, churches and government agencies.

Pearls Africa Foundation – Abisoye Ajayi-Akinfolarin who in 2012 founded Pearls Africa Foundation is another name to reckon with in that she was the one who started Girls Coding, which equips young girls with functional IT skills that will create economic independence. Girls aged between 10 and 17 years are taught programming, UI design and animation. They also get to relate with female mentors in the technology space. (<https://pearlsafrica.org/about-us>)

Inspire IT – This is an organization, founded by Nuela Adanna Ononiwu 2014, and focuses on mentoring girls in basic computer skills, programming skills and information technology consultancy. More than thirty girls have been mentored by Nuela via the initiative which took off in 2014. She hopes to see more women and girls connect through the mentoring programme.

Code IT – Another initiative is Code IT, which is aimed at developing young people in the area of computer science by focusing on building hardcore programming skills at an early age. The initiative, which targets children between the ages of 5 and 18, was founded by Damilola Anwo-Ade who is passionate about the development of IT skills in young people especially girls. CodeIT aims to train 10,000 children by the year 2020.

5. WOMEN CHANGING THE WORLD OF STEM PRESENTLY

Among some of the women who are currently leaving their indelible mark in the STEM industry worldwide are:

Rabia Sa'id:

Dr. Rabia Salihu Sa'id is a great inspiration for the female scientists of the younger generation. Although she completed her Ph.D. in Physics in 2013, her contributions have speedily given her local and international recognitions as a foremost scientist. She was one of the winners of the Elsevier Foundation Awards for Early Career Women Scientists in the Developing World in 2015. She was featured in *Nature* (The International Weekly Journal of Science) and in the BBC Radio Program: Discovery Science. She was also listed on the BBC 100 inspirational women of 2015. Currently an Associate Professor in the Department of Physics at the Bayero University in Kano (BUK), she was appointed Deputy Dean (female) at the Student Affairs between 2012 and mid-2016. Dr. Sa'id obtained her P.h.d in Physics from Bayero University, Kano. She holds an M.Sc. and B.Sc. in Physics from the same university. She also holds an M.Sc. in Environment and Development from the University of Reading in the United Kingdom; a study she undertook with a fellowship from the Ford Foundation in 2002. She spent four months in 2010 at the Institute of Applied Physics, University of Bern, Switzerland as a visiting research scientist, working with the renowned scientist in terrestrial and atmospheric remote sensing, Prof (Dr.) C. Matzler.

She is a volunteer for several non-governmental organizations including the Virginia Gildersleeve International Fund. She mentors girls and boys in the STEM field for which she volunteers at the Visiola Foundation and the Peace Corps Nigeria Alumni Foundation (PCNAF/ICEADA) Young Women Mentors Programme. (Wikipedia, April 2019)

Folasade Olajuyigbe, Ph.D

In world dominated by men, one of Nigeria's bright lights and a globally renown scientist, Folasade Olajuyigbe, Ph.D, who is also a senior lecturer in the Department of Biochemistry, Federal University of Technology, Akure (FUTA), reached a new high when she was announced the winner of the 2017 Fulbright African Research Scholar Programme (ARSP), award for advanced research in the United States for the 2017/2018 academic session. Following her award, the FUTA don is now affiliated with Rutgers, the State University of New Jersey. The Fulbright African Research Scholar Programme (ARSP) offers senior faculty members from top African universities the opportunity to conduct independent research at U.S. institutions. She was picked from a pool of 700-strong candidates who initially applied for the fellowship from Nigeria. Out of these, 16 were shortlisted for the interview, from where five finalists were picked. Olajuyigbe, whose research into enzyme biotechnology and environmental health has won her recognition, will focus on this area during her stint in one of the most prestigious international exchange programmes in the world. Fulbright Scholars (Senior Research Program category) are highly motivated academics with strong academic background, professional achievements, high leadership potential, passion for increasing mutual understanding among nations and cultures and serious commitment to completing the programme and returning home. Olajuyigbe is all these and more and, what is more interesting is that she keeps going stronger in the field, both home and abroad. (The Guardian, May 2017)

Kimberly Bryant

Kimberly Bryant is doubly shaping the future of technology with her organization Black Girls Code. Bringing both innovation and diversity to programming, Black Girls Code makes programming careers accessible to a population historically shut out of STEM careers through a six-week course on coding and robotics. Performing these calculations by hand, or even simple machines, was too slow for a war that moved at the speed of flight, so they were chosen to help program the first electronic digital computer, known as ENIAC, in 1946. (Source: <http://www.ecpi.edu>, 2015).

Rana el Kaliouby

Many consumers struggle to understand new technologies and advances in computing. Rana el Kaliouby is helping computers understand us with her innovations in facial recognition and reading technology. One of the founders of Affectiva, her inventions help people on the autism spectrum read facial expressions, assist researchers as they track subjects' emotional changes, and advertisers track reaction to campaigns in real time by reading viewers' expressions. Performing these calculations by hand, or even simple machines, was too slow for a war that moved at the speed of flight, so they were chosen to help program the first electronic digital computer, known as ENIAC, in 1946. (<http://www.ecpi.edu>, 2015).

Dr. Crystal Jensen

Technology must be accessible in order to improve people's lives. Dr. Jensen is the founder and president of Integrity Technologies, Inc. makes educational technologies available to Native and indigenous communities, which often lack technology-rich learning environments. Through online learning and social media, Jensen helps people access educational and economic opportunities and other information to improve the quality of life in traditionally marginalized communities. Performing these calculations by hand, or even simple machines, was too slow for a war that moved at the speed of flight, so they were chosen to help program the first electronic digital computer, known as ENIAC, in 1946. (Source: <http://www.ecpi.edu>, 2015).

Sandrine Mubenga

Improving energy efficiency and expanding the use of renewable energy sources will be one of the chief challenges of the 21st century. Sandrine Ngaulula Mubenga is helping us meet this challenge by developing a hybrid car that runs through hydrogen and solar-powered hydrogen fueling stations. Mubenga's prototype reaches a maximum speed of 119 miles per hour, outpacing concerns about the effectiveness of hybrid cars. Performing these calculations by hand, or even simple machines, was too slow for a war that moved at the speed of flight, so they were chosen to help program the first electronic digital computer, known as ENIAC, in 1946. (Source: <http://www.ecpi.edu>, 2015).

Amy Sheng

Technological advances have rapidly improved access to health care. But your doctor's office may soon be as accessible as your mobile phone, thanks to Amy Sheng. Sheng's team at CellScope is developing tools that work with mobile phones to connect with medical offices for remote examinations and tests. The hospital trials, if successful, could transform models for triage and monitoring chronic conditions. Performing these calculations by hand, or even simple machines, was too slow for a war that moved at the speed of flight, so they were chosen to help program the first electronic digital computer, known as ENIAC, in 1946. (Source: <http://www.ecpi.edu>, 2015).

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

As more efforts are put into the education, training and opportunities creation for Nigerian women and in STEM fields, there is no doubt that women will become dominant participants in STEM in the near future. The need for more women in STEM roles goes beyond simple diversity or gender parity. It is not just a case of making the STEM workforce fair – more women are needed in STEM roles to make scientific innovations useful, and more importantly, safe. After all, how relevant can innovations really be if they do not even take into consideration the needs of half the population?

The seatbelt is an example of this point, when it was first invented, it was modelled solely on the physical attributes of men, so when it was first introduced as a safety measure in cars, several women and children died because their physicality had not been considered. (Barratt, 2018)

Without more women being present when these decisions are made; and a diverse range of women at that, STEM innovations, progressions and discoveries can only go so far. The ripple effects of women in STEM reach far and wide. As Wollaston, (2018) reflected at the WISE 2018 Awards, “science and engineering and tech are fundamental to the future of the planet, we need women to take their rightful place in creating that new future

Besides this, enabling women to flourish in the STEM workforce is worth a lot financially. According to a research undertaken in the UK by McKinsey Global Institute, gender parity in the STEM workplace could add up to \$28 trillion (or 26%) to the annual global GDP by the year 2525.

As evidenced by the many women who have left their footprints in the sands of time with regards to the STEM field and the countless many who are making waves with their unique perspective and intellect, women are beginning to take a firm foothold in the industry and show a steady rhythm which will in time outpace their male counterparts in the STEM field as it is happening in every other field of human endeavour. Therefore, engaging women and girls in STEM sector work is not only the right thing to do from the point of social justice. It is also smart economics.

6.2 Recommendation

As seen from the above mentioned women who have braved the storm and are doing well for themselves in the STEM field; it is very possible for the girl-child to be successful in that field and even make giant strides towards the betterment of all. To enable this to be achievable, the following recommendations are suggested:

- **Sparkling Interest:**

The first step is getting young women interested in STEM education and careers at an early age. Although, schools do focus on subjects that are crucial to the foundations of engineering, such as math and science, but I think the link between the core subjects and the exciting, creative, and diverse careers within engineering that may appeal to young women is made clear to them at a time that is too late or not at all. This, in turn, could be a reason for the lack of girls considering a job in the industry. Also, companies need to showcase the work they do to spark STEM interest, such as hosting open days. At occasions like this the students may take part in a variety of activities, including behind-the-scenes tours, workshops, and talks from inspirational engineers. Parents and children can also ask questions about engineering careers, and find out more about the important role engineering plays in the world at large. I believe that today, young women need four influencers actively working together to identify their STEM potential and interest, encourage them and help them to develop, and provide opportunities for their interest to grow. These four influencers are; family (parents, siblings, etc.), school teachers and coaches, other role models, and industry.

- **Getting Educational Institutions on Board**

Schools in Nigeria have really come a long way with regards to imparting knowledge, but further improvements are necessary. Parents must be encouraged to become advocates in the school system for their young daughters who show interest in STEM education. Teachers should be trained to recognize interest and be advocates for inclusion of young women who show interest and/or potential in STEM fields. And industry must partner with schools, colleges, and universities to provide scholarships, internships, and other programs that help young women pursue STEM education and careers. Government has a role to play in this as well by providing incentives to schools that develop programs to promote STEM education for young women. Giving teachers opportunities to visit companies and connect with women in STEM careers can entirely change the way they teach and promote STEM material. Connecting educators and industry leaders to more innovative and relevant curricula throughout the secondary school pathway also generates opportunities for female students and teachers alike to be mentored by successful women working in STEM. It is very powerful for female students to hear directly from women who have achieved academic and professional success in STEM fields. However, it is hard to know the right moment to pitch engineering to young people. Therefore, schools have a role to play and need to do more to instill in girls the confidence to opt for science and math at A-level, and employers need to do more to make their approach to recruitment and retention more female friendly.

- **Ensuring Equal Employment Opportunities**

Hiring women for STEM positions is just the first step to what should be long and fulfilling careers. It is so easy to hire a qualified young woman, put her on a STEM team, and check the box that says ‘I did my part by hiring a bright young woman to fill that STEM opening on my team.’ But making the hire is just the beginning. So often there are other issues related to corporate culture and team dynamics that must be addressed—issues that are sometimes overlooked or just plain ignored—and that surface after the hiring process. For example, a STEM team may be predominately male. Women who enter STEM professions may find themselves surrounded by senior-level men who have either never worked with a woman peer or have no desire to work with a woman as a peer. And, unfortunately, sometimes women who have finally been ‘accepted’ as a part of these teams may immediately view the ‘new girl’ as a threat and offer little or no help or support. Every team member must be educated so that they and management understand the importance of diversity and inclusion to the success of the entire team and the company. Companies need to see that retention initiatives are a long-term investment. When women and men have the same degrees and the same level of experience, there is no logical reason for men to make more money and have better professional opportunities. This unbiased method may yield results will bring about a more diverse workforce, further enabling recruitment and retention of talented women.

REFERENCES

- Adefunke, E., Negar, A. A., (2013). Enhancing girls’ participation in science in Nigeria: A driver for National development and social equity
- Barratt, B., (2018). The need for more women in STEM roles goes beyond simple diversity. Forbes Online Magazine, November, 2018. Retrieved from <https://www.forbes.com/sites/biancabarratt/2018/11/17/the-need-for-more-women-in-stem-roles-goes-beyond-simple-diversity/#67e3602645cb>.
- Chattopadhyay, R., and Duflo, E., (2004). Women as policy makers: Evidence from a randomized policy experiment in India. *Econometrica*, 72(5) 1409–1443.
- Chijioko, N., (2017). “Don wins 2017 Fulbright African Scholar Fellowship”. The Guardian Online Newspaper, May, 2017. Retrieved from <http://m.guardian.ng/tag/folasade-olajuyigbe>
- Hunt, J., Jean-Phillipe, G., Herman, H., and David, J. M. (2012). Why Are Women Underrepresented amongst Patentees? *Research policy* 42 (4): 831–43.
- Huyer, S. (2015). Gender and International Climate policy: An analysis of progress in gender equality. Retrieved from <http://ccfas.cgiar.org>

- Joy, L., Harvey, M.W., Sriram, N.(2007). The bottom line: Corporate Performance and Women's representation on boards. Retrieved from <http://www.catalyst.org/research/the-bottom-line-corporate-performance-and-womens-representation-on-boards/>
- Milli, J., Williams-Baron, E., Meika, B., Xia J., and Gault, B., (2016). Equity in Innovation: Women Inventors and Patents. Report, IWPR #C448. Washington, DC: Institute for Women Policy Research. Retrieved from <http://iwpr.org/publications/pubs/equity-in-innovation-women-inventors-and-patents/>
- Ovseiko, V. P., Alison, C., Laurel, D. E., & Sue, Z. (2016). Advancing gender equality through the Athena SWAN Charter for Women in Science: An exploratory study of women's and men's perception. Health Research Policy and Systems 2017. <http://doi.org/10.1186/s12961-017-0177-9>
- Rabia, S. S., (2015). Tough as nails: Female scientists rise up in Nigeria. Retrieved from <http://www.npr.org/sections/goatsandsoda/2015/02/17/tough-as-nails-women-scientists-rise-up-in-Nigeria>
- Sugimoto, C. F., Lariviere, V., Ni, C., Gingras, Y., & Cronin, B. (2014). Global gender disparity in science. *Nature*, 504, 211 – 213.