Tectonic Shifts:

How do we get girls more involved in technology?

Developments in Science, Technology, Engineering and Mathematics (STEM) impact us all. Even more so with the digitization of everyday life. There have been interesting trends with gender representation in the tech industry. These include a marked underrepresentation of women in enrolment, matriculation, and employment in IT and STEM related disciplines. This underrepresentation of women continues in STEM related careers and leadership roles in these areas. 'STEM Education' across all grade levels in different settings can be transformational and has massive implications for the global workforce.

Academic research into why fewer women enrol, graduate and work in STEM related fields across different cultures in the UK, the US and the Caribbean all arrived at the same conclusions. While there is little difference in academic performance between male and female students in Computing programmes, there were clear biases in the enrolment, retention and graduation of female IT students.[123] Why? We don't know. Or rather, we can identify glaring correlations with the data that we do have. We discuss a few later in the article and present possible causes and solutions.

We are all already fully swept up on the wave of the current technological revolution. There are some well-known leaders at its crest – based solely on the disrupting influence they have had on events ushering in and sustaining the tide. Bill Gates may ring a bell, as will Elon Musk, Steve Jobs, and Mark Zuckerberg. But how did we get here? There was Alan Turing Father of the "Turing Machine", a theoretical model on which modern computing is based. But did you know about the very first computer programmer?- **Ada Lovelace**. Her notes on the "Analytical Engine" became the inspiration for Alan Turing's "Turing Machine" a century later in the 1930s. She recognised that the machine had applications beyond simple calculation. She then wrote the first algorithm for it.

Turing's ideas became the first computer and Lovelace's became the first computer program. By the 1960s **Katherine Johnson** was optimizing these programs by manually verifying the computer's math. Her work helped the US win the space race against Russia. It also advanced human space exploration immeasurably –the irony of Johnson doing her computations by hand is evident.

The absence of the contributions of female pioneers like these from the popular psyche possibly forshadowed gender representation trends in STEM and tech today.

The Face of Tech

In a PwC survey of 2,176 university students in the UK (1,102 females and 1,074 males) 83% of female respondents found it impossible to name a role model in the tech industry that inspires them to pursue a career in the field compared to only 59% of male respondents. Only 22% of all the students could name a famous woman working in the industry today[2]. The face of Technology, Science, Engineering and Math is male. The number of male and female students enrolling at the university level in STEM related programmes are comparable, as is academic performance in these programmes. The marked difference exists in graduation rates and entry into the workforce.[3]

"*If louder voices are heard celebrating the achievements of women in tech, and STEM in general, more women will feel empowered in their career choices, and young people will be inspired to consider a future in STEM"*

*–**The Women Who Changed the Tech World**.*
Amelia Whyman

In the above article by Amelia Whyman, some past and present pioneers are saluted, if only briefly. She presents it simply, if the impact of women doing extraordinary things in the field is celebrated alongside movements of the tide, and if their stories are told, girls can see clear pathways to places in tech where their talents fit perfectly. 50% of the females interviewed[2] say the most important

factor when choosing a future career is feeling like the work they do makes the world "a better place/has a wider impact". This also is a larger discussion when we consider salary disparities between men and women later in the article- In the UK, the technical sector has the fourth highest gender pay gap of all industries[2].

Diversity within the industry and a workforce is a concern because we need as many perspectives on our global issues as possible- male or female. Representation ensures one's interests are considered when decisions are made. This is far reaching and also affects the bottom line. Being able to enage with customers effectively requires a diversely representative workforce.

It is striking that only 23% of persons working in STEM fields in the UK are women and only 5% of those in the field are in leadership roles. In the US, while women make up 47% of the workforce they represent only 25% of those employed in computing related jobs. In Jamaica, there is little difference in school enrolment and academic performance between males and females at all levels of education[3]. It gets more interesting at the tertiary level.

A study at the University of the West Indies found that across all its campuses women represented 40% of those enrolled in Computer Science programmes but only 20% of graduands with a Computing degree. The barrier doesn't appear to be competence, skill or academic performance. In the same study at some campuses women actually demonstrated marginally higher GPAs than men in Computing programmes. Similarly, in the US, only 38% of women who majored in a Computer Science degree are employed in the field compared to 53% of men[1]. Some research suggests lower confidence in their abilities as being associated with lower matriculation from STEM fields for women[3]. This underscores the need for female role models and mentors whose contributions to the discipline and industry are celebrated alongside their male counterparts.

Both PwC and Google studies have found that at the secondary school age, girls were presented with STEM related subjects as career options less often than boys were (33% of boys reported being encouraged to pursue a career in STEM compared to 16% of girls)[2]. In the Google study, girls reported that they went into tech because they were encouraged to.

So, girls deciding to go into tech cite encouragement at around secondary level when they are selecting career choices (and when role models are important). We present them STEM subjects as options less often than we do for boys resulting in less women entering the field, less role models and less visible pathways into technical fields. This is a problem because it restricts the number of *people* participating in areas in the workforce which impact all areas of our lives. If that doesn't matter to you then it also affects the bottom line – technology is a a billion dollar industry and improvements in the workforce impacts all lives.

"Every 10% increase in the female labor force participation rate... is associated with a 5% increase in wages for both men and women..."

When More Women Join the Workforce, Wages Rise

Amanda Weinstein

New educational opportunities in secondary schools are important as girls at this level expressed a desire for creative pathways in tech. In the PwC study girls reported not finding STEM subjects as interesting and choosing to do subjects that they got better grades in. Reasearch into curriculum design geared at making STEM concepts, subjects and careers more appealing to girls seems more than neccessary. 52% said that their preferred career was a factor in their selection of A-Level subjects.[2]

The same study also reported that men were more likely to select careers based on salary. This is especially impactful in high income industries such as tech. Could this be why there is such salary disparity between men and women in STEM fields and an even wider underrepresentation of women in leadership roles? The impact on lifetime earnings is clear.

Technology impacts us all, science impacts us all. Representation for half of our population is absent from participation in the vehicle instrumenting change in their lives. This impacts economic development strategies based on digital transformation. Female participation in the labor force increases wages for all workers.

The goal is then greater participation of women in the technical (STEM) workforce. We could start to do this with;

Early Exposure:
This is early introduction of STEM subjects and career pathways to girls both in formal and informal learning settings.

Varied Career Choices:
Present STEM principles in varied ways to increase interest. Varied visions can use science and technology to solve global issues in innovative ways.

Female Role Models: Ada Lovelace and Kathryn Johnson took some girls decades to find as role models. These women should have been presented alongside the male pioneers and their contributions celebrated as universal role models. Let's have more places (hopefully here) that celebrate the accomplishments of women, highlighting their involvement in the technology industry and have spirited discussion around STEM Education.

Curriculum Design: Findings are consistent across inquiries about low comparative participation of girls and women in STEM fields and careers. A green field for exploration lies in education in these areas and how these principles are presented to female students Namely, discussions surrounding teaching and learning in STEM.

Address Salary Disparities: Representative discussions on existing salary disparities must drive changes in employment policies. This could be a consecuence of an already wide disparity in the competitiveness of smaller regions amongst more larger ones or incentives geared specifically for women. This should be part of a larger more nuanced discussion to come.

How can we remove barriers to female entry in science and technology fields? This is a discussion we hope to continue in this series – exploring new and different ways of viewing and working in tech. If blending poetry and data structures sound delightful, stay tuned! We will also explore any interesting things we come across on female disruptors and tectonic shifters on the current wave.

1. *Whyte, S, 2020: Women in tech statistics: The hard truths of an uphill battle*
2. *PwC 2017: Women in Tech Time to close the gender gap*
3. *Fokum, D. Coore, D. Fokum, Y. 2014: The Performance of Female Computer Science Students across Three Caribbean Islands*
4. *Google, 2014: Women Who Choose Computer Science- What Really Matters. The Critical Role of Encouragement and Exposure*
5. *Fox, M, 2020: Katherine Johnson Dies at 101: Mathematician Broke Barriers at NASA*

- *Shannika Jackson February 2021*