Gender Gap in STEM

Jon Bowen
MRes Experimental Neuroscience, Imperial College London
STEM People Research team
# Table of Contents

I. Executive Summary ................................................................. 2
II. Introduction ............................................................................ 2
III. Women in STEM ................................................................. 3
IV. Women in STEM Education .................................................. 5
V. Closing the Gap ................................................................. 7
VI. Conclusion ........................................................................... 9
VII. References .......................................................................... 10
Executive Summary

This article looks at the gender gap that is thought to exist between males and females in the Science, Technology, Engineering and Maths (STEM) professions and education. It finds that there does appear to be an under representation of women in both STEM careers and education, but only for certain subjects, with a pattern of lower female involvement in these subjects appearing at A-level and continuing through to careers. The article then investigates some of the issues that may cause this pattern to form, such as implicit bias within the STEM fields and teaching as well as the problems that gender stereotyping can cause. The article then suggests some remedial measures to close the gap; better teacher training and providing role models and early exposure to the STEM field to combat gender stereotyping. It concludes with a look at how closing the gap will benefit the individual and society as a whole.

Introduction

Diversity in the STEM fields has often been a topic of controversy in the UK. This article deals with the distinct lack of diversity between the two biological sexes within STEM education and professions, although this is not the only diversity issue within the STEM fields. It is often suggested that men are over represented both in STEM professions and higher education (1). For many, the idea that males are over represented in these roles runs counter to the diverse and inclusive nature of our society, surely increased inclusiveness can only open up a wellspring of new ideas and talents to an area that is strongly reliant on creativity and innovation. STEM professionals are not born into the profession, they must be taught the skills, analytical tools and thought processes that will allow them to thrive in that environment, this process should be open to all regardless of gender. According to the American Psychological Association, although there are some biological cognitive differences between men and women, these are small and become almost non-existent when compared to factors such as culture and early exposure (2). Furthermore, a 2009 study found that gender disparity in Math’s performance decreased as gender equality in that culture increased, suggesting that these differences were cultural and environmental to begin with (3). Despite this evidence, a gender gap does appear to exist in the UK and it is a worrying trend worldwide (4). What makes the gender gap problem all the more pressing is the desperate shortage of skilled STEM professionals in this country; according to a 2015 survey by the Confederation of British Industry (CBI) 32% of businesses in the sector struggled to find employees with adequate STEM-related skills, with this number only expected to increase over the next three years (5). A large proportion of Britain’s economy is reliant on those STEM professionals, not just to drive innovation but to keep the country on an even keel. The majority of the time, to treat one group preferentially based on gender is seen as morally wrong, it seems downright irresponsible to ignore half the population when there is a skill shortage. Whatever argument you choose; ethical, pragmatic or philosophical it is clear that the STEM fields cannot continue to ignore and be under representative of such a huge sector of the British population.
Women in STEM

According to estimates based on The Office of National Statistic Labour Force Survey and compiled by the WISE Campaign, currently women make up 14.4% of the UK STEM workforce (6). According to the statistics this is an improvement on recent years. Statistics like these look black and white, it appears that men have been offered STEM positions to the detriment of women, but caution should always be applied in interpreting such important statistics. There is a famous case dealing with gender discrimination at the University of Berkley in the USA during the 1970s. It appeared that certain faculties in the prestigious University were favoring male applicants over females due to a disparity in the overall number of women holding positions there. However, this disparity disappeared when looked at the details by the department, in fact, in some instances women were preferentially hired but these positive examples were drowned out by the overall lack of applications from women (7). When exploring the statistics from the UK in more detail it reveals slightly more subtlety to this problem as well, because when the STEM professions are broken down into their constituent parts, a different picture is revealed. In the roles of Health professional and Associate Health Professionals, women actually outnumber men (by 53.7% and 63.4% respectively) and as Science professionals there is a relatively even spread between men and women (50.5% to 49.5% respectively). However, for the next group of STEM professionals (Science and Engineering Technicians), women are outnumbered by men almost three to one (6). From there it is a steep decline to the bottom of the pile: Skilled Trades based on STEM where only 0.7% of professionals are women (6).

Figure 1: A bar chart illustrating the disparity in gender representation in various STEM fields. Ideally there should be a roughly even split such as in science Professionals but this is not the case in many STEM fields. Data based on ONS Labour Force Survey as represented on the WISE Campaign website (6).
How can it be that society can trust women with their health and wellbeing, but not with research, buildings or computers? It’s not that the gap has grown overtime, quite the opposite, the gap has always been there, what makes this all the more concerning is that many of these careers did not exist a couple decades ago, they started off with the gap already there. If the gap cannot be put down to historic precedent, then the question still remains as to its origin. There are a couple of likely candidates. Firstly, there is prejudice when hiring people for STEM positions. Although it is preferable to believe that gender bias plays no role in hiring decisions a recent study has shown that it may play more of a role than we first thought. When given an identical CV with the only difference being whether the first name was John or Jennifer, science faculty members at leading universities rated the male CV as a much more desirable candidate, even going so far as to hypothetically offering a much higher staring salary to “John” (8). This illustrates the unfortunate fact that for women to do well in STEM careers they must consistently outperform their male counterparts, meaning that they need better training to bridge the gap. This feeds into the second, and arguably greater, explanation as to why the gender gap exists in the STEM field, not as many women complete STEM education as men.
Women in STEM Education

It is a truth universally acknowledged, that a woman in search of further education will usually not pick a STEM topic. Women are underrepresented in all parts of STEM education after the General Certificate of Secondary Education (GCSE), where the majority of STEM related subjects are mandatory. This is a great shame as girls outperform boys in Biology, Chemistry and Physics at GCSE level attaining higher percentages of A* to C grades (9). In fact, at GCSE girls outperform boys in every subject except Maths (64.7% of boys attain an A* - C grade compared to 63.5% of girls) (9,10). Girls continue to outperform boys in STEM subjects at A-level but this success is mitigated by the fact that relatively few girls take STEM subjects at A-level (11). In 2015 only 20% of female students took Math’s compared to 39% of male students, this was much worse for Further Math’s with only 2% of female compared to 8% of males opting to take this subject (see Figure 2) (12). This trend continues for all the STEM subjects except for Biology where females up take outnumbers that of males, with 21% of all female students choosing it compared to 17% of all male students. This is of little consolation though when 20% of all male students are taking Physics and only 4% of all female students do so (12).

![Uptake of STEM Subjects at A-level by Gender](chart.png)

**Figure 2:** A bar chart showing the uptake of various STEM subjects as A-level as a percentage of the total male and female student population. Data based figures from Department from Education (12)

The pattern is clear and it is one that continues on to Higher Education subject choices, with women slightly over represented in Biology related subjects (the Life Sciences) but massively underrepresented in all other STEM subjects with the worst offenders being Computer Science and Engineering and Technology degrees with females making ups only 17% and 14% respectively, of students graduating with these degrees in 2015 (13). From this data it can be seen that this pattern is set at the point of A-levels and continues into careers, diverting female talent away from the majority of STEM careers. Obviously some of this is through free choice, not everyone wants to do STEM related subjects, but based on GCSE results it would be expected that more girls pick STEM related topics. It seems clear that some gender stereotype bias is shunting bright, talented girls away from choosing STEM related topics, even though all the evidence suggests that they can perform just as well as boys in these subjects. This stereotype of the STEM field being exclusive to males is suffuse within our society, no matter how inclusive we claim to be, and is probably one of the biggest barriers to women entering the field at all levels.
Stereotypes are insidious things and can manifest themselves in various ways, but a recent study in the USA suggests that one of the most damaging ways stereotypes can affect girls is through the implicit biases carried by their teachers (14). This study found that teacher’s biases from an early age had a negative effect on girls but a positive effect on boys leading to far more boys and fewer girls taking advanced Math’s courses in later life (14). Obviously this is something that needs to be guarded against and proper training of teachers to recognize and mitigate these implicit biases within their teaching is of upmost important to any society that wishes to be truly inclusive. However, this in itself does not tackle the problem of the stereotype held by the young girls about their own ability in STEM subjects. To tackle this the media must take a leading role, research has shown that when faced with counter stereotypical images there is an increase in non-typical gender role beliefs in women compared to women confronted with stereotypical images (15). When looking at the role of a stereotypical STEM field worker as portrayed through the lens of modern media it is obvious that there is a distinct lack of diversity and this may well be one of the major causes for currently held stereotypes and as a consequence for the gender gap in the STEM field itself (15). This vicious cycle of stereotype begetting self-fulfilling prophecy will not be an easy problem to combat but it is both necessary and right to try, as a nation, to change it.
Closing the Gap

The myriad of problems that plague the STEM field with regards to diversity have no easy solution. However, there are definitely steps that can be taken in the right direction that are of little cost but maximal benefit to all involved. For example, one of the key factors in encouraging women into STEM careers and education is early exposure to STEM subjects (17). The key to this is a well-rounded early educational experience. Of major concern in this respect should be the now nationally mandated Acadamisation of all Primary and Secondary schools in England due to be completed by 2022 (18). The most pressing issues with Academies is that under their own authority they have no obligation to hire teachers with Qualified Teaching Status (QTS), meaning that a Teacher can be hired without having had the relevant and appropriate training. Proper teacher training should eliminate any implicit bias within the teacher’s own practice and equip the teacher to properly deliver a robust syllabus. An increase in the number of schools able to hire teachers that do not have QTS could lead to an increase in the gender gap in the STEM field.

Without private entities willing to step in and bridge the gap in training and experience, it could be disastrous for the whole industry of this country. Another small but effective step in the right direction would be encourage and facilitate exposure to STEM role models that buck the current stereotypes in the STEM field. Numerous studies have shown that exposing girls to female role models in the STEM field can help combat implicit stereotypes that young people may hold and even go so far as to improve their performance in STEM related tests (19). This should not be too much of a problem as there is a litany of accomplished female scientist both past and present, who can be held up as role models from Madame Curie to May-Britt Moser. However, chances are that, although most people have heard the former name, they have little to no idea who the latter is. This highlights one unfortunate consequence of underrepresentation; under exposure in the media and popular culture. It is at the stage that Wikipedia, a notoriously egalitarian website, have to run a WikiProject to ensure that their coverage of female scientists is fair and representative (20).

Figure 3: Madame Curie and May-Britt Moser. Both Nobel prize winners, both excellent female scientists and role models but one is far well known than the other. Picture Credit: May-Britt Moser By NTNU Trondheim - Kavli-5941, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=43067935
The media must also play a role in the solution to this problem. As a reflection of society the media should be a champion of inclusion and diversity in all fields, however, it often falls short of that mark. This can be remedied by society holding the media accountable for what it shows. This is a process that is down to each individual to question what they see in the media and encourage those around them to do the same. All of these ideas can, alone and in concert, help to close the gap. There is not one solution to this problem but many, as varied and wide ranging as the factors that caused this issue in the first place. The more women that get into STEM roles, the more role models there will be available for young girls deciding about their career. This should hopeful tackle societies’ stereotypes of women in STEM fields and create a virtuous cycle that eventually bridges the gender divide. The solutions to the diversity issues in the STEM field are out there, what cannot happen at this time is that this problem is ignored because, regardless of the moral imperatives, without a diverse and skilled STEM force, there cannot be a productive and profitable Britain.
Conclusion

With all the statistics about the gender gap it is easy to lose focus on the human aspect. When talking about abstracts we forget that even a single person being discriminated against for any reason is a great tragedy at a personal level. When taking a broad view of topics, it is not often that the individual is empathized with, the frustration and unfairness of the system is not experienced on a personal level. This is unfortunate because if this viewpoint was considered it should become blindingly obvious how morally indefensible it is to have a system that works in this way when we claim to be a multicultural and meritocratic society. It is well within the power and capabilities of the current generation to create a virtuous cycle of change to bridge the gender gap in the STEM field and generally speaking change does seem to be in a positive direction; there were over 100,000 more women working in STEM fields in 2015 compared to 2014 (6).

However, this change is progressing at a slow pace, nowhere near fast enough to divert the impending crisis in skilled STEM recruitment. Although progress is generally forward, slipping backwards on any gains must also be guarded against. Although women are currently well represented in the medical profession, the present Government’s new junior doctor’s contract unfairly penalizes females wishing to start families (21). If pushed through in its current form such a contract could see a reduction in women in the medical profession and a consequent increase in the gender gap. Back tracking on any gains is the last thing that anyone wants as it would break the momentum of the current progress. As the STEM fields have an increasingly large impact on how we live in and relate to the modern world, it does not make logical sense that the people driving that progress are not reflective of society. Such an imbalance could lead to missed opportunities to address issues that some members of society face but that are invisible to the current STEM cohorts because they never experience them. Innovation comes from facing problems and by tackling the gender gap issue the STEM field will help itself to become more innovative, which can only be to its advantage.
References


