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Addressing the STEM Gender Divide: from school to tertiary education

Sandra McNally [University of Surrey – s.mcnally@surrey.ac.uk]

Although the share of women achieving tertiary education exceeds that of men, women are severely under-represented in maths-intensive STEM fields (Science, Technology, Engineering and Maths). But this under-representation does not just start at the onset of tertiary education. In many countries, students have considerable choice within upper secondary school (or high school). The different choices taken by girls and boys influence the extent to which they are 'STEM-ready' by the time they make decisions on what to study in tertiary education. For example, this has been recently documented for Canada and Ireland. In those countries where student choices within tertiary education are more gradual (following the liberal arts tradition), women are less likely to major in maths-intensive STEM subjects or are more likely to switch out of such majors. If we wish to influence the gender gap in tertiary education, we must consider interventions that influence 'STEM-readiness' by the end of upper secondary school as well as choices among the 'STEM-ready'.

WHY DO THE STEM-READY NOT PURSUE MATHS-INTENSIVE FIELDS?

The literature suggests that even among the highly able, girls can lack confidence in maths or demonstrate a lower willingness to compete, especially in very male-dominated environments. These factors do not operate in isolation, however. They interact with the environment and culture in which individuals find themselves. The psychology literature suggests that the 'masculine culture' of computer science, engineering and maths is problematic. This is defined as being "a social and structural environment that signals a greater sense of belonging to men than women" (Cheryan et al., 2017). Aspects of this masculine culture include stereotypes of STEM fields that are incompatible with the way many women see themselves, negative stereotypes and perceived bias, and few role models for women.

WHAT CAN BE DONE?

CAREERS INFORMATION AND GUIDANCE

Challenging gender stereotypes and providing equal opportunities for women and men are goals of the European Commission Gender Equality Strategy.[1] One aspect of addressing the 'masculine culture' perceived of some STEM fields is to better convey the range of careers that different fields might lead to. As students do not have much exposure to subjects such as engineering and technology during school, their impressions of such fields might not be well informed and they may be overly influenced by stereotypes. Research by economists and psychologists emphasises the importance of preferences for explaining gender differences in occupational choice (e.g. Eccles and Wang, 2016; Zafar, 2013). For example, Eccles and Wang (2016) find that gender differences between entering occupations that are maths-intensive (geosciences, engineering, economics, maths/computer science and physical science) and other STEM fields (life sciences, psychology, and social science) are best predicted by women's greater preferences for work that is altruistic and people-orientated, compared with men's preferences for thing-orientated work. It is important that men and women understand how their goals may be fulfilled in different fields.

Although it is also important to inform students about wage expectations associated with different careers, this is less effective for influencing choices than directly influencing their preferences (Zafar, 2013; Osikominu and Pfeifer, 2018).

[1] https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_357

FEMALE TEACHER AND MENTORS

For the 'female friendless' of maths-intensive STEM fields to have credibility, it is essential that women are better represented as educators within these fields. There have been several convincing studies showing the importance of teachers/mentors at the tertiary level. For example, one study for the US (Carrell et al., 2010) shows that being assigned to a female professor has a powerful effect on female students' performance in maths and science classes, their likelihood of taking future maths and science courses and their likelihood of graduating with a STEM degree. The effects are much larger for students with high maths scores. The results are similar to those of another US study (Canaan and Mouganie, 2019), where students are assigned to academic advisors in the first year of college. Being matched to a female rather than a male science advisor substantially narrows the gender gaps in STEM enrolment and graduation, with the strongest effects occurring amongst students who are highly skilled in maths.

The review by Cheryan et al. (2017) emphasises the potential importance of role models in the literature more generally. They note that the patterns of existing under-representation mean there is a greater scarcity of potential female role models in computing, engineering and physics than in biology, chemistry and maths. However, they emphasise relatability rather than gender exclusively as a relevant trait of a good role model. These are people with whom students feel a sense of connection, similarity and identification.

Increasing female role models may be a way of influencing the preferences of women. This is a conclusion of Zafar (2013), who finds that most of the difference in STEM at the tertiary level is driven by gender differences in tastes and preferences. He concludes "a possible policy implication…is to encourage policies that increase the representation of females in academic science and engineering, since these female professors may change female students' beliefs and preferences toward STEM coursework and careers."

CONCLUSION

There are numerous interventions to encourage more girls and women to enter and stay in STEM fields. But much more needs to be done to evaluate programmes in a scientific manner and to collate and disseminate results. High quality evaluations may do much to inform what is known and implemented to improve female engagement in STEM.

REFERENCES

Canaan, S., and P. Mouganie. (2019). Female Science Advisors and the STEM Gender Gap. IZA Discussion Paper. No. 12415.

Cheryan, S., S. A. Ziegler, A. K. Montoya and L. Jiang. (2017). Why Are Some STEM Fields More Gender Balanced than Others? *Psychological Bulletin*. 143(1):1-35.

Card, D., and A.A. Payne (2017). High School Choices and the Gender Gap in STEM. NBER Working Paper 23769.

Carrell, S. E., M.E.Page and J. E. West. 2010. Sex and Science: How Professor Gender Perpetuates the Gender Gap. *Quarterly Journal of Economics*. 125(3): 1101-1144.

Delaney, J. M. and P. J. Devereux, (2019). Understanding Gender Differences in STEM: Evidence from College Applications. *Economics of Education Review* 72: 219-238.

Eccles, J. S., and M. Wang. (2016). What Motivates Females and Males to Pursue Careers in Mathematics and Science? *International Journal of Behavioral Development*. 42(2): 100-106.

Osikominu, S., and G. Pfeifer. (2018). Perceived Wages and the Gender Gap in STEM Fields. IZA Discussion Paper No. 11321

Zafar, B. (2013). College Major Choice and the Gender Gap. *Journal of Human Resources*. 48(3): 545-595.

For more details see: Sandra McNally. *Gender Differences in Tertiary Education: What explains STEM Participation?* EENEE Analytical Report 41, May 2020. http://www.eenee.de/dms/EENEE/Analytical_Reports/EENEE_AR41.pdf. See also **Encouraging Girls into STEM: what can schools do? Policy Brief 2**

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