

Do Girls and Boys Feel Equally Confident in Their Mathematics Abilities? Evidence from TIMSS 2015

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Despite the importance of science, technology, engineering, and mathematics (STEM), not enough students are interested in pursuing a STEM career. Moreover, among the few students who do show an interest – and do pursue a STEM career – the proportion of women is small. For example, in [OECD countries](#)¹, only 23% of tertiary education graduates belong to the field of science and engineering and only 31% of these students are women. This underrepresentation is also seen in academia, where only 22% of scientific authors are women.

[Spearman and Watt \(2013\)](#)² proposed three explanations for the STEM gender gap: (1) differences in ability between boys and girls, (2) differences in motivation and attitudes towards STEM, and (3) differences in socialization. In terms of ability, results from several cycles of TIMSS and PISA show that, in most countries, there are no significant gender differences in mathematics achievement and, if they exist (usually in favour of boys) they have narrowed over the years. Studies have shown that the desire to pursue a STEM career seems more closely related to the second explanation, especially to attitudes such as mathematics self-concept (how confident students feel of their own mathematics abilities). These attitudes are shaped by the environment surrounding girls and boys, which refers to the explanation of socialization. For example, girls and boys might be influenced by gender stereotypes that identify mathematics and mathematics-intensive fields as typically male domains. These gender stereotypes can be conveyed by significant adults – such as parents and teachers – as well as the [media](#)³.

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¹ <https://doi.org/10.1787/9789264268821-en>

² https://link.springer.com/chapter/10.1007/978-94-6209-209-9_10

³ <https://seejane.org/wp-content/uploads/portray-her-infographic.pdf>

Despite small or non-significant gender differences in mathematics achievement, research has shown considerable male advantages in mathematics self-concept. This research has been mainly conducted in Western countries and with secondary school students. The aim of our study was to explore gender differences among younger students and in a wider set of countries, and to assess the role that socialization has in shaping students' self-concept.

Assessing the gender gap

Using data from TIMSS 2015, we explored gender differences in mathematics self-concept among fourth-grade students in 32 countries⁴, taking into account student achievement and socialization variables. For the latter, we used parents' attitudes and characteristics (e.g., attitude towards mathematics and science, the frequency to which they did early numeracy activities with their children) as a representation of socialization at home.

Our findings

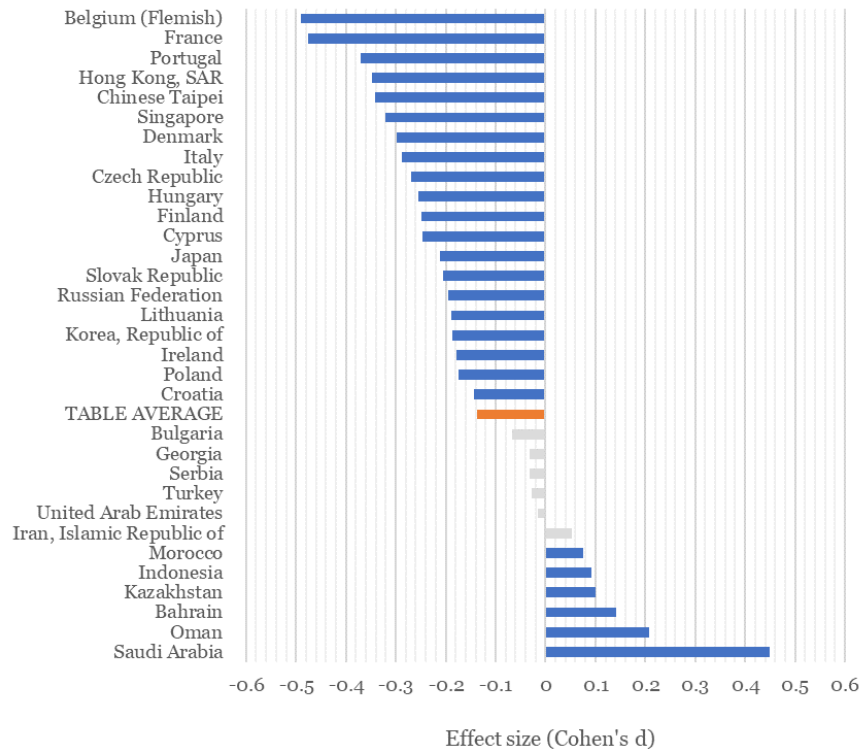
Our results indicate that gender gaps in mathematics self-concept already exist among grade 4 students and, therefore, develop before the age of ten. Although the association between gender and self-concept varies across countries, girls have lower self-concept than boys in most of the countries (see Figure 1). A further look shows that girls tend to perceive their mathematics ability more negatively compared to boys not only in countries where girls (on average) performed less well than boys, but also in countries where girls performed equal to or even better than boys.

Why should we care about girls' lower mathematics self-concept?

Previous research shows that confidence in mathematics ability is an important predictor of whether girls choose to study more advanced mathematics courses and, in some cases, these choices can determine access to STEM fields of study in university. Although students in fourth grade are far from making such choices, if girls

⁴ Bahrain, Belgium (Flemish), Bulgaria, Chinese Taipei, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Georgia, Hong Kong SAR, Hungary, Indonesia, Islamic Republic of Iran, Ireland, Italy, Japan, Kazakhstan, Republic of Korea, Lithuania, Morocco, Oman, Poland, Portugal, Russian Federation, Saudi Arabia, Serbia, Singapore, Slovak Republic, Turkey, and United Arab Emirates.

Fig. 1 Effect of gender on mathematics self-concept, by country.



Note. Significant effect sizes ($\alpha < .05$; two-tailed) printed in blue; positive effect sizes indicate advantages for girls and negative effect sizes indicate advantages for boys.

already have a low mathematics self-concept by then, it might be too difficult to encourage their STEM participation in the future.

Women participation in STEM is a matter of concern. If women are as able as men to pursue a STEM career but do not do so because of a low mathematics self-concept, we are losing an important source of talented STEM workforce, which could impact productivity and innovations. Furthermore, STEM participation can bring better economic prospects for women, as STEM jobs are among the fastest growing and lucrative careers.

We must work together to ensure girls have the same opportunities as boys when it comes to STEM education, fighting against gender stereotypes and encouraging girls' achievement and confidence in subjects like math.

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