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Innovation and technology for gender equality

The latest facts on gender equality in education

Gender gaps persist in innovation and technology

- Innovation and technology can be instrumental in achieving gender equality and the empowerment of girls and women. Achieving this requires girls and women to be involved in the fields of technology and innovation and their rights in online spaces to be protected.

- Innovation can be understood as the 'implementation of a new or significantly improved product – good or service – or process, or a new marketing method, or a new organizational method'.[1] For innovations to be beneficial and desirable – as not all of them are – they need to shape sustainable and peaceful futures for all people, rooted in social, economic and environmental justice. To do this, they need to be directed at equity, inclusion and democratic participation.[2]

- Science, technology, engineering and mathematics (STEM) industries are at the centre of innovation and technology advancements. They are the jobs of the future, driving social well-being, inclusive growth and sustainable development. Yet, women remain under-represented in STEM careers. Globally, women make up 29% of research and development positions in science, with the lowest proportions in Southwest Asia (19%) and East Asia and the Pacific (24%). Women are also under-represented at all levels in the technology sector. This is particularly so in leadership positions, where they represent only 24% of professionals.[3]

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- In the field of artificial intelligence (AI), only 22% of professionals are women. Just 18% of authors at leading AI conferences are women. The under-representation of women in this sector contributes to the reinforcement of gender stereotypes through AI systems, such as misogynistic voice assistants. Siri, a female-gendered voice assistant used by hundreds of millions of people, for example, has been shown to give submissive responses in the face of gender abuse.[4]

- More men than women have access to the internet. It is estimated that globally in 2022, 69% of the male population was using the internet compared to 63% of the female population. This means 259 million more men than women were using the internet in 2022. And over the last three years, gender parity in internet access in the world has increased only slightly, moving from a gender parity index of 0.90 in 2019 to 0.92 in 2022.[5]

- In all regions of the world, except for Europe and North America, more men than women are using the internet. There are pronounced gender gaps in digital access in the least developed countries, where only 30% of women use the internet compared to 43% of men, with hardly any progress towards gender parity over the last three years.[6]

- Data on younger populations are limited. In countries with data, girls aged 15 to 19 were less likely than boys to have used the internet in 2021, and also had lower mobile phone ownership. The greatest disparities were in South Asian countries.[7]

- Women's uptake of mobile internet in low- and middle-income countries continues to increase, but the rate of adoption has slowed down. Across low- and middle-income countries, 60% of women now use mobile internet. However, only 59 million additional women started using mobile internet in 2021 compared to 110 million in 2020. Women are still 7% less likely than men to own a mobile phone and 16% less likely to use mobile internet. This translates into 264 million fewer women than men using mobile internet.[8]

- Girls aged 9 to 17 suffer disproportionally from violence online or via mobile phones. On average, 54% of girls reported suffering from online violence compared to 48% of boys. Girls were more likely to report being treated in a hurtful or nasty way via social networks (38%), text messages (21%), mobile phone calls (16%) and chatrooms (5%).[9]

Gender disparities emerge in school, negatively impacting girls' and women's participation in the development of innovation and technology

- Girls are significantly less likely than boys to pursue technology-related studies, even though girls are doing at least as well as boys in mathematics and science in the majority of countries. Globally in 2018, only 28% of engineering and 40% of computer science graduates were women.[10]

- In 2019, in 30 out of 121 countries, fewer than 20% of graduates in engineering were women. In 61 out of 115 countries, fewer than 30% of computer science graduates were women. The lowest share of female graduates were found in Saudi Arabia for engineering (3%) and Cambodia for computer science (8%).

- Confidence is key for entering STEM fields. An analysis of 2019 data from the International Association for the Evaluation of Educational Achievement (IEA) Trends in Mathematics and Science Study (TIMMS) found that more boys than girls at grade 8 want to pursue a mathematics- or science-related career. For both girls and boys, high confidence in mathematics or science skills is associated with a higher likelihood of wanting to enter a job in those fields. The analysis showed that boys at grade 8 report being more confident in mathematics than girls. This gender difference was less pronounced in science.[11]

- The results of the Organisation for Economic Co-operation and Development's (OECD) Programme for International Student Assessment (PISA) showed that less than 1% of girls in OECD countries, but nearly 8% of boys, wanted to work in occupations related to information and communications technology (ICT).[12]

- Girls' confidence in mathematics and science can be negatively affected by peers, parents, teachers and school counsellors who hold or even propagate gender stereotypes in STEM. For instance, a survey of secondary school counsellors in Wisconsin, United States, found that even though the counsellors believed female students were more likely than male students to succeed in mathematics, they were less likely to recommend mathematics over English to female students. Likewise, teaching and learning materials can perpetuate stereotypes in STEM. For example, only 6% of the characters in the Chilean grade 6 science textbook were female.[13]

- Low levels of confidence can persist into adulthood. An analysis of TIMSS 2015 data found that female science and mathematics teachers reported lower levels of self-efficacy than male teachers. Yet, their students performed as well or better than students taught by their male peers. Female teachers may be underestimating their capacities in transmitting science and mathematics knowledge. As female teachers are important role models for girls, the lower self-efficacy of female science and mathematics teachers may affect girls' own self-efficacy in these subjects.[14]

- Many girls and women do not have the same ICT skills as boys and men, and the gender gap in these skills is apparent at every level. Among 10 low- and middle-income countries with detailed data, women are less likely to have used a basic arithmetic formula in a spreadsheet in the 7 poorest countries, while parity in this area was found only in the 3 richest countries.[15]

- In European countries, 25 women for every 100 men at most have sophisticated ICT skills, such as programming, and only 7% of ICT patents in G20 countries are obtained by women.[16]

- The COVID-19 pandemic showed that many learners do not have access to online learning. Digital learning often benefits privileged learners and widens educational inequity, creating further disadvantages for girls and women.[17] In many sub-Saharan African countries, fewer girls than boys possess ICT skills, and girls are less likely than boys to use computers and the Internet when those are available at home.[18]

Despite progress, gender disparities persist in access, skills and the quality of education[19]

ACCESS

- Over the past 20 years, gender gaps in enrolment and attendance have been in decline. Still, the primary enrolment rate of girls has increased by only 11 percentage points since 1995 from nearly 79% to 90% in 2020 – less than half a point per year.

- Although this rate has increased faster than boys', whose enrolment rate increased from 86% to 92% over the same period, getting every girl into primary school will not happen until 2050. According to new estimates available at Visualizing Indicators of Education for the World (VIEW) website (www.education-estimates.org), 118.5 million girls of primary and secondary school age are out of school. These data do not reflect the potential impact of COVID-19 on education systems.

- Girls still face significant barriers to their right to education in some countries. In Afghanistan, girls have been banned again from secondary schools and tertiary education. In Benin and Chad, boys are more than twice as likely as girls to complete upper secondary school.

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- Poverty is one of the most important barriers to girls' education. In over 20 countries, mostly in sub-Saharan Africa but also in Afghanistan, Bangladesh, Guatemala, Haiti, India and Pakistan, less than 10% of poor, rural, young women have completed upper secondary school. In Benin, Cameroon, Congo and Mali, hardly any of the poorest girls have completed upper secondary education.

- In Malawi, Nigeria and Sierra Leone, marriage and pregnancy keep some 10% of adolescents – mostly girls – out of education. School-level decisions, stigma and unequal gender norms lead to the exclusion of many pregnant adolescents and young mothers from school.

- According to HerAtlas, worldwide, 2% of countries restrict the right to education of married, pregnant and parenting girls and women in their legal framework.[20]

SKILLS

- In 2020, women still accounted for almost two-thirds of all adults unable to read – 478.5 million of them lack basic reading skills, with very little improvement seen over the past two decades. In rural areas, women are even further behind: in at least 15 countries, women aged 25 to 64 from rural areas are twice as likely to be illiterate as those from urban areas.

- In high-income countries, boys tend to score higher in computational thinking – solving problems through logical and algorithmic reasoning – which is an important component of digital literacy. This contrasts with computer and information literacy, where girls tend to score higher.

QUALITY

- School-related gender-based violence, in its physical, sexual and psychological forms, affects children's and youth's school attendance, well-being and learning. Evidence from five low- and lower-middle income countries shows that girls are more likely than boys to miss school due to physical violence perpetrated by classmates and teachers or due to unwanted sexual experiences. In Honduras, 57% of girls who reported having suffered physical violence by teachers missed school, compared to 39% of boys.[21]

- School may be the only place some children have access to water, sanitation and hygiene facilities. In Liberia, few households have hygiene facilities that meet the basic international standard, but 69% of schools do. School-based water, sanitation and hygiene facilities can support girls' menstrual hygiene, reduce absenteeism and facilitate their retention in education during adolescence.

- The proportion of female teachers continues to increase. Between 2000 and 2020, in pre-primary education this proportion increased from 92% to 94%, while in primary education it rose from 59% to 67%. The largest increases, of some 17 percentage points, were observed in Central and Southern Asia and in Eastern and South-eastern Asia. Sub-Saharan Africa was the only region where female teachers made up less than half of the teaching staff in primary and less than one-third in secondary education, with no change in relative proportion since 2015. This emphasizes the importance of role models in a region where girls' access to education remains relatively limited compared to that of boys'. Similar efforts are needed for male teachers in the context of boys' disengagement from education.[22]
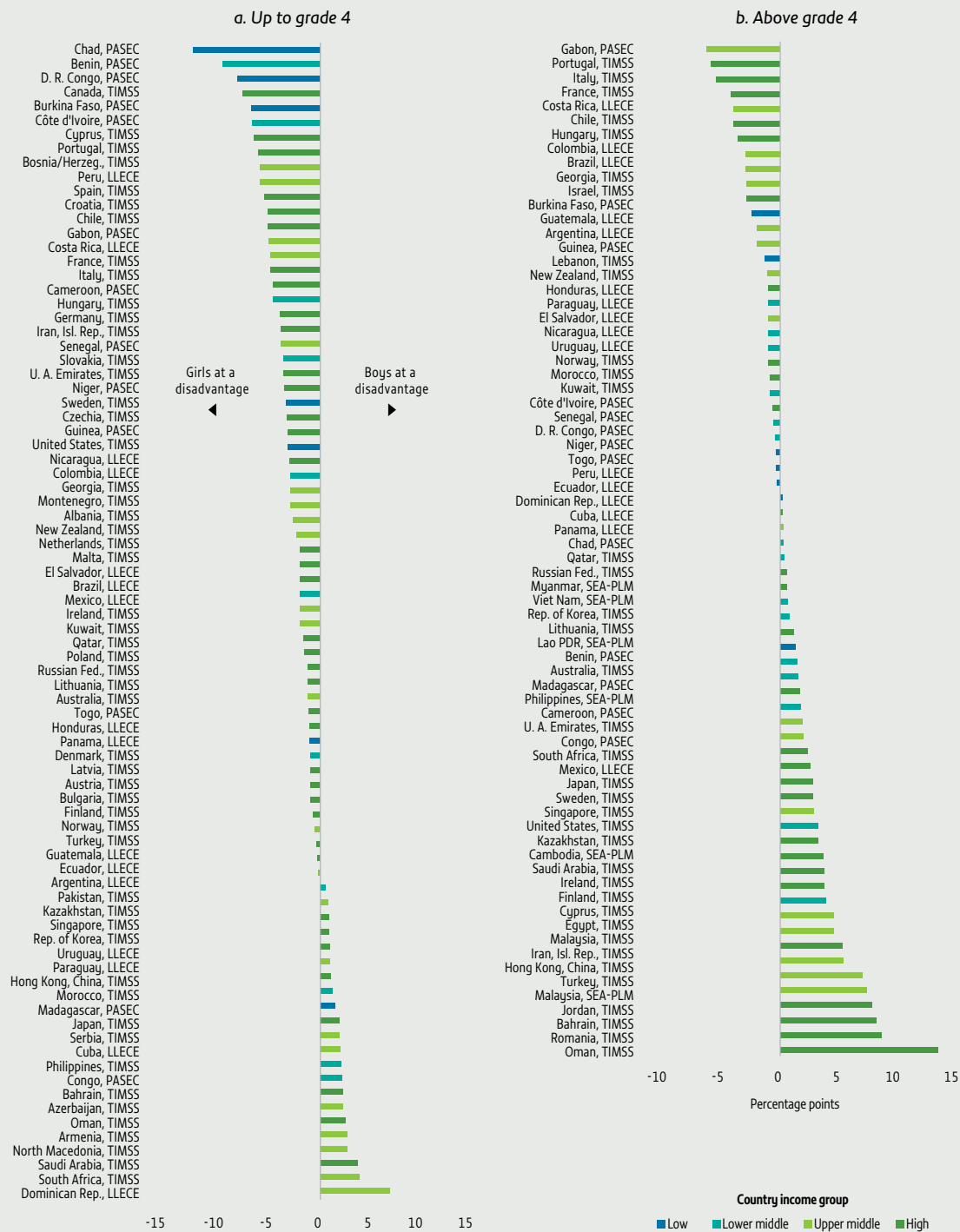
LEARNING

- Boys tend to perform better than girls in mathematics, particularly in early grades, and they are far more likely to be among the top performers. For instance, around 70% of grade 4 girls and boys achieved minimum proficiency in mathematics in Australia in 2019 – but 37% more boys achieved advanced proficiency. The gender gap in minimum proficiency in mathematics drops in later grades and has shrunk over time.

- In middle- and high-income countries, girls outperform boys in science in secondary school. Large gaps are observed in the Arab States, where girls face greater barriers and boys enjoy a higher social status independent of effort. Among grade 8 students, the percentage of girls achieving minimum proficiency exceeds that of boys by 21 points in Bahrain, Jordan and Oman (**Figure 1**).

- When girls perform well in mathematics and science, they perform even better in reading. This may be one reason girls are less likely to opt for scientific careers, but it is important to unpack the stereotypes that play a critical role in affecting such choices.

FIGURE 1:

In mathematics, a small gender gap favouring boys in early grades gradually disappears
Female-male gap in share of students achieving minimum proficiency level in mathematics, 2019

a. Up to grade 4

b. Above grade 4

Source: GEM Report team estimates based on the 2019 rounds of the LLECE, PASEC, SEA-PLM and TIMSS surveys.

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Globally, access for the poorest girls remains an acute problem

FIGURE 2:

In many countries, the poorest girls are twice as likely to be out of school as the national average.

Out of school rates for primary education by gender and wealth (WIDE) and modelled out of school rate trends from 2000 – 2020 (VIEW), selected countries

Nigeria

Female, poorest, 66
Male, poorest, 63

Male, richest
Female, richest

Pakistan

Female, poorest, 59

Male, poorest, 42

Male, richest
Female, richest

Benin

Female, poorest, 64

Male, poorest, 55

Female, richest
Male, richest

Cameroon

Female, poorest, 42

Male, poorest, 32

Female, richest
Male, richest

Chad

Female, poorest, 81
Male, poorest, 77

Female, richest
Male, richest

Sources: World Inequality Database in Education (WIDE) (https://www.education-inequalities.org/) and Visualizing Indicators of Education for the World (VIEW) (https://education-estimates.org/)

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The World Inequality Database in Education (WIDE), managed by the GEM Report and the UNESCO Institute for Statistics, highlights the powerful influence of gender, combined with other factors such as wealth, ethnicity and location, over which people have little control but which play an important role in shaping their opportunities for education and life. WIDE data shows that in some countries, the gap in primary out of school rates between the poorest girls and the national average is over 25 percentage points (**Figure 2**). In Pakistan, 59% of the poorest primary-age girls are out of school, compared to 42% of the poorest boys and to the national average of 23%. In some cases, the poorest children have considerably lower chances of going to school, but the gender gap within wealth groups is small. In Nigeria, 66% of the poorest girls and 63% of the poorest boys are out of school, compared to 28% of children on average. In 9 countries around the world, the poorest girls spend less than 2 years in school on average.

Girls' disengagement from education is due to so many factors, including child marriage, early pregnancy, discriminatory gender norms in society, child labour and the lack of easy and safe access to schools near where they live. These girls need to be given a second chance to re-join education systems, and have access to accelerated learning opportunities so that they can catch up on their time lost.

Gender-transformative education is key in boosting innovation and technology

Girls and women are the greatest population as yet untapped to advance technology and social innovation to achieve sustainable development – we must invest in their talent. Gender-transformative education is essential in empowering girls and women to contribute fully to STEM fields. Gender-transformative education seeks to address the underlying causes of gender inequalities, and not only addresses the different needs, aspirations, capacities and contributions of girls and boys, women and men, and non-binary learners but also challenges discriminatory norms, policies and practices. To make the most of the power of gender-transformative education, governments and partners need to:

- Put gender equality at the heart of education sector plans, budgets and policies and scale up gender-transformative STEM and ICT education. This includes promoting learning environments that support girls to pursue ICT and STEM subjects by addressing harmful gender norms, stereotypes and discrimination among all learners. It also includes building teacher capacities, ensuring that gender-transformative STEM and ICT education is included in national curricula, and improving career guidance and orientation.[23]

- Increase access to ICT for women and girls. This must go hand-in-hand with information and skills related to online rights, online safety and how to mitigate risks online. Increasing ICT access for women and girls includes formal, school-based interventions along with access to clubs, camps and other informal opportunities to complement and build on school-based approaches.[24]

- Ensure access to role models and mentors, including in particular women successful in STEM fields to debunk stereotypes and myths about gendered abilities and careers, to expand understanding of educational and career pathways in these fields, to enrich skills, networks and social capital, and to help girls transition into the STEM workforce.[25]

- Close the digital divide and develop digital solutions that ensure the full and equal participation of all learners. This implies the need to harness the potential of technologies for inclusion and avoid overreliance on only one particular technology, closing gaps in digital access, knowledge, digital skills and leadership.

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- Centre policies, actions and investments in education technology on the most marginalized. Start by asking how approaches can work for vulnerable and marginalized girls and women as well as other disadvantaged groups.[26]

- Prevent online bullying, gender-based violence and transform harmful gender norms, students' and teachers' attitudes, behaviours and skills to support justice, inclusion, health and gender equality. [27]

- Bring parents on board. This includes the design and implementation of parental outreach programmes to dismantle harmful gendered stereotypes about intelligence, aptitude and 'appropriate' fields of study for women and raise awareness of the importance of digital skills for girls, including online rights and safety, and available safeguards and controls. An overemphasis on safety is also often used as a justification for preventing women and girls from using technology and cultivating digital skills. Parents need to be supported to transform attitudes that reduce the autonomy of girls.[28]

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