GLOBAL EDUCATION MONITORING REPORT

2024

GENDER REPORT

Technology on her terms

UNESCO

Sustainable Development Goals

Global Education Monitoring Report

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Gender Reports of the *Global Education Monitoring Report* series

2022	*Deepening the debate on those still left behind*
2020	*A new generation: 25 years of efforts for gender equality in education*
2019	*Building bridges for gender equality*
2018	*Meeting our commitments to gender equality in education*
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SHORT SUMMARY

What role can education play in determining whether technological development is gender equal?

The 2024 Gender Report tells the increasingly positive story of girls' education access, attainment and achievement, which is helping reverse decades of discrimination. But there is much more to say on gender equality in and through education. A companion to the 2023 GEM Report, this report looks at the interaction between education and technology with a gender lens.

First, it looks at the impact of technology on girls' education opportunities and outcomes. Although many instances are seen of radio, television and mobile phones providing a learning lifeline for girls, particularly in crisis contexts, gender divides exist globally in both access to technology and in digital skills, although the latter are smaller among youth compared to among adults. Biased social and cultural norms inhibit equitable access to and engagement with technology in and outside of school, with girls always left on the wrong side of the divide.

The share of women among STEM graduates is 35% and has not changed in the past 10 years.

While technology offers many girls opportunities to access important education content in safe environments, for instance on comprehensive sexuality education, technology in practice often exacerbates negative gender norms or stereotypes. Social media usage impacts learners' and particularly girls' well-being and self-esteem. The ease with which cyberbullying can be magnified through the use of online devices in the school environment is a cause of concern, as is the biased design of artificial intelligence algorithms.

Second, the report looks into the role of education on the shape of future technological development. It shows that women struggle to pursue STEM careers, which manifests from an early age in the form of anxiety in mathematics and develops into a reluctance to study STEM subjects, ultimately resulting in a lack of women in the technology workforce. Women make up only 35% STEM graduates, and hold only a quarter of science, engineering and ICT jobs. Ensuring women participate on equal terms in shaping the world's ongoing digital transformation will ensure that technology works for everyone and takes into consideration the needs of all humanity.

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"Since wars begin in the minds of men and women, it is in the minds of men and women that the defenses of peace must be constructed"

GLOBAL EDUCATION MONITORING REPORT

2024

GENDER REPORT

Technology on her terms

Foreword

Technology is a tool. It promises easier access to education; personalized and enriched learning experiences. Yet, technology is not yet gender neutral.

This Global Education Monitoring report, *Technology on Her Terms*, tells us a lot about technology in education, especially its role in replicating and amplifying gender biases.

First, our report underlines that men and women have unequal access to information and communication technologies: 130 million fewer women than men own a mobile phone, for instance, and 244 million fewer women have Internet access worldwide – even though digital tools can be a lifeline for girls and women in rural zones, poorer areas, and crisis situations.

Moreover, according to this report, not only are some women and girls unable to access the learning opportunities that the digital transformation may offer, but they are also unable to help shape it on an equal footing.

Indeed, women are currently underrepresented in the technological design and deployment process: in 2022, women held less than 25 per cent of science, engineering and information and communication technology jobs. Today, they represent only 26 per cent of employees in data and artificial intelligence.

This lack of representativity has real consequences on algorithms and data sources, which perpetuate and amplify gender biases. With all too predictable results: according to a recent UNESCO study of generative AI models, a woman is described as a “model” or a “waitress” in 30 per cent of automatically generated texts, while male names are associated with terms such as “business” and “career”.

This situation is also due to pernicious and powerful prejudices among content generators: negative stereotypes paint science, technology, engineering and mathematic as male-oriented fields, causing girls and young women to veer away from STEM career tracks – despite their very real capabilities in these domains.

These stereotypes are also widespread on social media, which girls spend more time on. Girls are therefore more at risk of being exposed to content promoting gendered professions, unrealistic body standards, the sharing of sexually explicit images, cyberbullying – all of which place added strain on their mental health and well-being, and in turn affect academic performance.

All these factors create a feedback loop: where girls are exposed to negative gender norms, steered away from studying STEM subjects, and deprived of the opportunity to shape the very tools that expose them to these stereotypes.

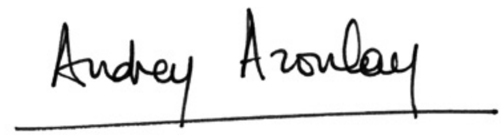
The solution, as underlined in our report, starts with education, which plays a major role in re-balancing the gender dimension of technology.

Reducing exposure to social media and negative gender stereotypes. Encouraging more girls to study towards scientific careers through women role models in STEM fields. Ensuring that technological applications are no longer predominantly designed by men. These are some of the recommendations set out in the following pages, which UNESCO is already urging policymakers to implement.

For example, our Recommendation on the Ethics of Artificial Intelligence, adopted unanimously by our Member States in November 2021, establishes a clear ethical framework that incorporates the continuous monitoring and evaluation of systemic biases in AI. Our Recommendation also underlines the importance of media and information literacy, to enable users of AI tools to think critically and deconstruct stereotypes.

In addition, UNESCO recently launched Women4Ethical AI, a collaborative platform to ensure that women are represented equally in the design and deployment process. And, every day, we train teachers to transmit their passion for science to girls and women – so they can become future actors in these fields.

Ultimately, the main lesson of our report is this: technological progress may support educational and social progress – but only if we are the masters of technological tools, rather than their servants. Only if we leverage technology in education, on our terms.



Audrey Azoulay
Director-General of UNESCO

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KEY MESSAGES

What progress was achieved by the SDG midpoint?

Although pockets of extreme exclusion persist, on average girls tend to do as well in school, if not better than boys.

- Gender parity in enrolment was achieved in primary and lower secondary education in 2009 and in upper secondary education in 2013, which has been maintained ever since.
- But in sub-Saharan Africa, gender parity has not been achieved at any level of education. More girls are out of school than boys. Girls who start school late or repeat grades in the region are also far more likely than boys to leave school early.
- Pockets of extreme exclusion for girls and young women persist in poor countries, including the Democratic Republic of the Congo, Nigeria and Pakistan, where there is gender parity in school attendance among the richest but substantial disparity among the poorest.
- In technical and vocational education and training, of the 146 countries with data, 40 have a sizeable gap in favour of males in contrast to just 3 in favour of females.
- In tertiary education, parity was achieved in 1998, but by 2004, disparity started at the expense of men: by 2020, there were 114 women enrolled for every 100 men. Yet male students are still more likely to study abroad.

Countries are moving further away from their national SDG 4 benchmarks on gender parity in secondary education completion.

- In total, 36% of countries have set a national target on this gender gap, the lowest rate of all benchmark indicators.
- For countries where fewer young women than men were completing upper secondary school in 2015, the gender gap in completion rates fell from 6.9 to 4.2 percentage points in 2022 but should have fallen to just 1 point if countries had been on track.
- For countries where fewer young men than women were completing upper secondary school in 2015, the gender gap in completion rates increased from 6.8 to 9.5 percentage points in 2022, when it should have fallen to 5.5 points if countries had been on track.

Examining the gender gap in learning achievement not only at average but also at high levels of performance provides important insights.

- In reading, globally, for every 100 boys, there are 115 girls proficient at the end of lower secondary education.
- In science and mathematics, there is near parity at average levels of learning achievement, but boys have an advantage over girls at the higher levels of achievement.

Technology affects girls' education opportunities and outcomes

ICT can overcome barriers to education access for girls in crisis contexts.

- Radio and mobile phones have provided an education lifeline for girls banned from going to school in Afghanistan or affected by the Boko Haram crisis in Nigeria.
- Some features in technology design can help overcome barriers to education faced by girls. In Kenya, the M-shule platform delivers education through text messages on low-tech mobile phones with no need for an Internet connection.

Girls and women are on the wrong side of the digital divide.

- Girls and women are less able to access technology. For instance, 81% of men and 75% of women owned a mobile phone in 2023. In Pakistan, 22% of women without a phone cited lack of family approval as the primary obstacle, compared to 4% of men.
- There are 244 million fewer women than men using the Internet worldwide. A survey of girls and their parents in Ethiopia, India, Jordan, Kenya, Nigeria, Rwanda and the United Republic of Tanzania showed that parents tended to believe that girls require more protection than boys from potential online distractions and temptations.

There are large gender gaps in digital skills, but they are changing rapidly.

- The prevalence in the youth population of spreadsheet skills is about 1% in low-, 14% in lower-middle-, 33% in upper-middle- and 57% in high-income countries. The average gender parity index is slightly less unfavourable for young women (0.91) than for adult women (0.82). But countries vary: for every 100 young men with spreadsheet skills, there are only 40 young women in Chad but 117 young women in Egypt with such skills.
- The prevalence in the youth population of programming skills is about 0.5% in low-, 2% in lower-middle-, 6% in upper-middle- and 14% in high-income countries. While the average gender parity index is less unfavourable for young women (0.75) than for adult women (0.50), the disparity remains very large. For every 100 young men with programming skills, there are only 21 young women in Ireland, 24 in Hungary and 28 in Austria but 110 young women in Saudi Arabia, 118 in Albania and 130 in the State of Palestine with such skills.

Technology can help youth access sexuality education that might not be available elsewhere.

- Technology provides a safe and confidential environment for learning about sexuality. The Girl Talk app increased the sexual health knowledge of girls aged 12 to 18. Thailand has e-learning courses for teachers to learn about sexuality education.
- Radio and television have been proven to enhance knowledge on sexual and reproductive health rights. A radio drama in Nepal motivated 11% of those who listened to seek family planning services. Regular listeners of a BBC radio programme in Sierra Leone had a better understanding of the risks of child marriage.

Social media negatively affects well-being and reinforces gender norms.

- Girls are twice as likely as boys to suffer an eating disorder, which is exacerbated by the use of social media. Facebook's own research found that 32% of teenage girls said that when they felt bad about their bodies, Instagram made them feel worse.
- TikTok's algorithm targets teenagers with body image and mental health content every 39 seconds, and with content related to eating disorders every 8 minutes. In the United States, many universities have explicitly banned TikTok from campus.
- Greater interaction on social media at age 10 is associated with worsening socioemotional difficulties with age among girls, while no cross-associations were found among boys.
- Emotional well-being is linked to better academic outcomes. One longitudinal study of families in England found that children with better emotional well-being made more progress in primary school and were more engaged in secondary school.

Technology allows for cyberbullying, including through image abuse.

- Cyberbullying is common, and more so for girls and non-binary students. A global poll of children aged 7 to 18 showed that a higher share of those of unspecified gender (50%) than girls (37%) and boys (29%) consider it very likely they will encounter online harm.
- Image abuse is common. A third of undergraduate female students in Canada and 88% of girls surveyed in United Kingdom schools and colleges said that they had been sent pictures or videos they did not want to see.
- The danger of deepfakes made by artificial intelligence is spilling over into school environments. In Brazil and Spain, for instance, schoolgirls have been victims of deepfake pornographic images circulating in schools, while female teachers have been recorded as victims of the abuse in the United States.

Education can determine whether technological development is gender equal

Girls' confidence in STEM subjects is harmed early.

- Girls were found to be significantly less confident in mathematics than boys in all but two education systems that participated in the 2019 TIMSS survey.
- Girls who are more anxious in mathematics are less likely to perform well. At least a quarter of the variation in mathematics performance across countries could be explained by the differences in overall mathematics anxiety in each country.
- Boys' and girls' educational trajectories diverge at around the age when they start deciding about their careers. In Canada and Ireland, for example, different subject choices among boys and girls in secondary school explain most of the subsequent gender gap.

Girls are far less likely to study STEM subjects despite concerted efforts.

- In 2018–23, the share of STEM graduates who were female was 35%. Only in 9 out of 122 countries were the majority of STEM graduates female, notably Arab States, such as the Syrian Arab Republic and Tunisia. High shares of female STEM graduates in Arab countries coincide with lower mathematics anxiety.
- For a subset of 50 countries with data for 2010–11 and 2020–21, there has been no change in the share of STEM graduates who are female. There are notable examples of decline: Hungary (by 5 percentage points to 29%), stagnation (e.g. Chile where the share has remained at 20%) and improvements, such as North Macedonia (from 40% to 50%), the Netherlands (from 21% to 31%) and Morocco (from 39% to 49%).
- There is a large gender gap in tertiary field choices. The average share of STEM is 15% among young female graduates and 35% among young male graduates. Countries with the largest absolute gaps include Finland, Germany and Sweden, while Mauritania, Samoa and the United Republic of Tanzania are among the few countries with no gap.
- Countries are adopting various approaches to address gender divides. However, while 68% of countries globally have policies to support STEM education, only half of these policies specifically support girls and women.

Gender gaps in STEM crystallize in gender imbalances in the technology workforce.

- Women are far less likely to pursue STEM careers. Women held less than 25% of science, engineering and ICT jobs in 2022 and occupy just over one in five technology positions in companies. In 2022, only 17% of patent applications were filed by women globally.
- The digital transformation is led by men. Women constitute only 26% of employees in data and artificial intelligence, 15% in engineering, and 12% in cloud computing across the world's leading economies.
- A lack of women in the technology workforce is an economic loss to society. Doubling the share of women in the tech workforce by 2027 could boost GDP by EUR 600 billion.

Negative gender stereotypes impact on girls' STEM aspirations.

- Study choice can, but not always determines, career choice. Taking a computer science course in secondary school can increase the chances of majoring in computer science by 10 percentage points. Still, only one in four women with an IT degree technology took up digital occupations in the European Union, compared with over one in two men.
- Low expectations from parents and teachers can reinforce gender segregation. In Denmark, having a mother who is STEM-educated helps mitigate potential negative peer effects. Teachers may not always have a positive influence. In Latin America, up to 20% of mathematics teachers reported believing that their subject is easier for boys.

Aichata Togo, a 15-year-old 9th grader, takes her lessons on the radio. To enable pupils to follow the school curriculum, lessons are given on the national radio so that children can attend school from home. Thanks to COVID-19 broadcasts, Aichata and many other children have been able to follow their school curriculum and save their school year. Mopti region, central Mali.

Credit: © UNICEF/UN0431560/Keïta

What progress was achieved by the SDG midpoint?

The midpoint in the implementation of the 2030 Agenda for Sustainable Development was marked in September 2023 at the SDG Summit. There is a lag in education data production, but up-to-date reporting was further hampered by the fact that education data collection processes had been tested by the COVID-19 pandemic disruptions. The ultimate effects of school closures on education systems will remain hard to determine for a few more years. In the case of learning achievement, the first evidence from the world's richer countries documents a negative medium-term effect but it was less dramatic than feared. The long-term impact on learning will remain difficult to assess, as no shock of that magnitude had ever been experienced before. In the case of education participation and attainment, the data that emerge do not suggest a visible impact. A bigger issue may be, rather, that progress in access to education has almost ground to a halt over the past 10 years.

This first part of the 2024 Gender Report reviews progress on gender parity in education for most SDG 4 targets. Despite the kaleidoscopic range of possibilities to look at gender disparity (**Box 1**), the report documents the continuing growth in girls and young women's participation in education at different levels, which has helped reverse decades of discrimination. It also suggests that this long-term trend is going to continue, increasingly putting disadvantaged boys and young men at a worse relative position. But this is not a reason to lose focus on those countries where girls continue to lose out on education opportunities, a predicament that is not limited to Afghanistan. Last but not least, as this series of reports has continued to stress, parity is but one part of the effort for gender equality in and through education. With gender gaps in a wide range of social and economic outcomes, the role that education can play in that respect needs to be constantly reassessed and reconsidered.

BOX 1:

The global SDG 4 indicator on disparity is insightful but may not give the full picture

Global indicator 4.5.1, the parity index that compares the education status of two groups, one disadvantaged and one privileged, is defined in terms of other global education indicators (e.g. completion or learning), at various education levels (e.g. primary or secondary), and for various individual characteristics (e.g. sex or wealth). The potential combinations are so numerous that it is very difficult to talk of one trend. It is particularly challenging to make global comparisons in terms of characteristics whose definitions vary between countries. For example, definitions of urban and rural are not the same between countries, and neither are definitions of poor and rich. The latter definition may be based on income, consumption or wealth, with each concept having different meanings and leading to different conclusions.

In the case of gender disparity, global indicator 4.5.1 is more straightforward to interpret. Yet it only provides the relative disadvantage between males and females, while masking the absolute disadvantage. For instance, the gender parity index for the gross graduation rate from tertiary education was 0.56 in Burkina Faso, which meant that males were graduating at almost twice the rate as females, the lowest in the world. But at gross graduation rates of 3.7% for males and 2.1% for females, it is clear that the main issue is not disparity but low overall levels of tertiary enrolment and graduation. The parity index is important but needs to be reviewed jointly along with the actual levels of the indicator. It is more insightful to compare the parity index among countries which are at similar levels of the analysed education indicator, a logic used in relation to the national SDG 4 benchmarks (**Box 3**).

GLOBALLY, THERE IS GENDER PARITY IN PARTICIPATION AND COMPLETION

One of the most notable successes in the implementation of the international education agenda over the past 30 years has been the move towards gender parity in education. The world achieved gender parity in primary and lower secondary education **enrolment** in 2009 and in upper secondary education in 2013. Tertiary education progress has been different. Parity was achieved a decade earlier, in 1998, but by 2004, there was already disparity at the expense of men, which has continued to increase: by 2020, there were 114 women enrolled for every 100 men.

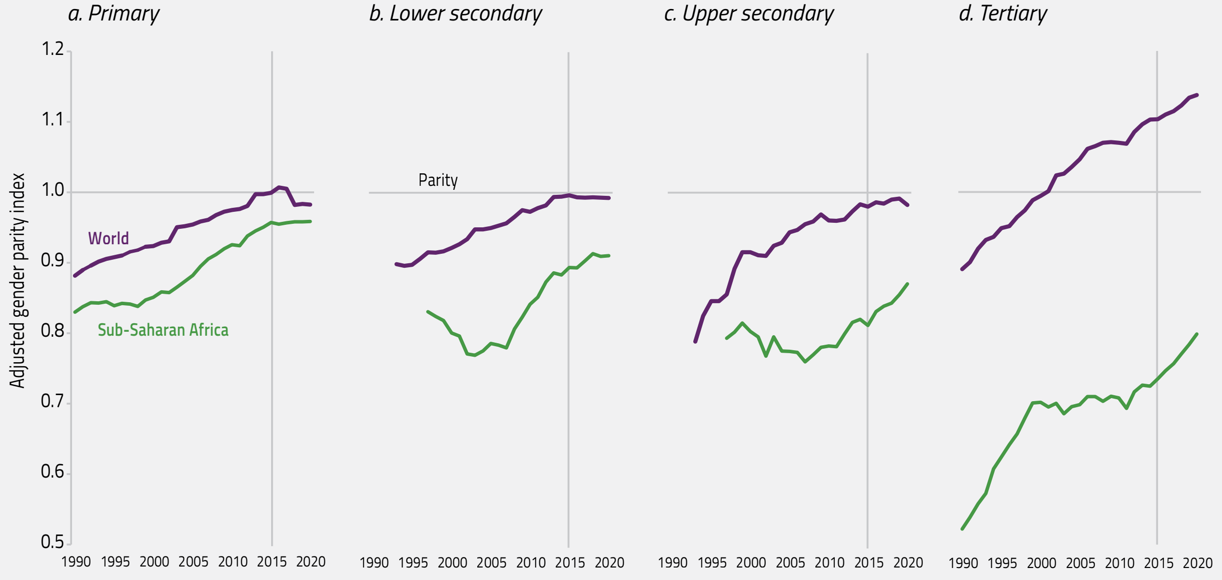
The one exception to this success has been sub-Saharan Africa where parity has not been achieved at any level of education. As of 2020, for every 100 males, there were 96 females enrolled in primary, 91 in lower secondary, 87 in upper secondary and 80 in tertiary education. Conditions for girls and young women worsened during the period of structural adjustment in the 1990s and disparity increased in secondary education. The 1997 level of the gender parity index in lower secondary enrolment did not recover until 2010. The 1999 level of the gender parity index in upper secondary enrolment did not recover until 2013. But between 2015 and 2020, the gender parity index in upper secondary enrolment improved at the fastest rate ever observed, by 0.012 points per year. Similar levels of progress have been achieved in tertiary education (**Figure 1**).

In absolute numbers, sub-Saharan Africa is the main world region where there are more girls of primary and secondary school age who are out of school than boys – and the out-of-school population is growing. Globally, 9 out of the 10 countries with the highest out-of-school rates are in the region (**Box 2**). In Northern Africa and Western Asia, it is estimated that the number of out-of-school boys may have just exceeded the number of out-of-school girls in 2022. In Central and Southern Asia, a long trend of a rapidly declining out-of-school population came to an end in 2022 as a result of the crisis in Afghanistan. In sub-Saharan Africa, slow declines in out-of-school rates mean that the out-of-school population has been rising. Since 2008, it is estimated that the number of out-of-school boys increased by 12 million to 48 million and the number of out-of-school girls increased by 9 million to 51 million. Globally, between 2000 and 2022, the number of out-of-school boys has fallen by 35% to 128 million, while the number of out-of-school girls has fallen by 41% to 122 million (**Figure 2**).

FIGURE 1:

Sub-Saharan Africa has not achieved gender parity in enrolment at any education level

Adjusted gender parity index of the gross enrolment ratio by education level, world and sub-Saharan Africa, 1990–2020

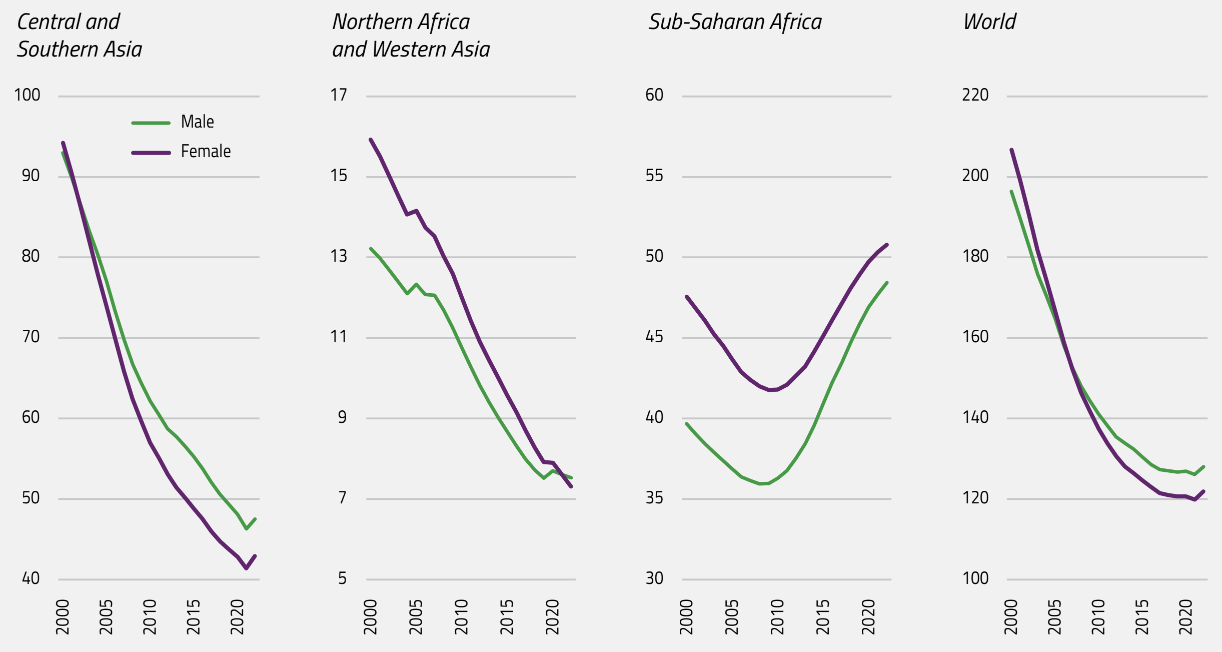


Source: UIS database.

FIGURE 2:

Sub-Saharan Africa is the only world region where there are more girls are out of school and the out-of-school population is growing

Out-of-school population of primary and secondary school age, world and selected regions, 2000–22



Source: VIEW database.

BOX 2:

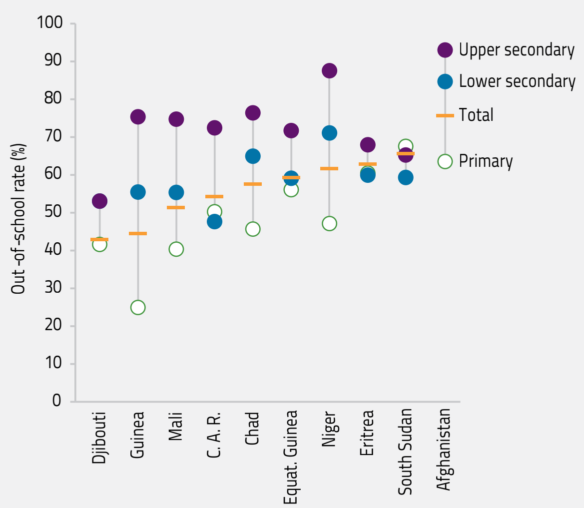
These are the 10 countries with the highest rates of education exclusion for girls

Data gaps in some of the countries with the lowest levels of education development mean it can be difficult to list the countries with the lowest education access rates for girls. A recent estimation model that makes efficient use of available information for all countries shows that 9 of the 10 countries with the highest out-of-school rates for girls are in sub-Saharan Africa, the 10th country being Afghanistan. In the median country, 49% of primary school age, 59% of lower secondary school age and 74% of upper secondary school age girls are out of school (**Figure 3**). Somalia would almost certainly have replaced Djibouti in this list if data were available.

FIGURE 3:

Apart from Afghanistan, 9 of the 10 countries with the highest education exclusion rates for girls are in sub-Saharan Africa

Ten countries with the highest out-of-school rates for girls, by age group, 2022



Source: VIEW database.

Among countries with disaggregated data from household surveys in the past five years, it is also possible to show the situation of the poorest girls facing the most extreme disadvantages. In Guinea and Mali, practically no poor young women are in school, putting them in the same situation as their Afghan sisters, who are officially banned from attending school.

Three aspects of these average trends of disparity need further examination: disparity in completion (rather than in enrolment); differences in countries' historic trajectories; and differences between the average population and selected groups where sex intersects with other factors of disadvantage.

AFRICAN GIRLS WHO START SCHOOL LATE OR REPEAT GRADES ARE MORE LIKELY TO LEAVE SCHOOL EARLY

First, enrolment is only a stepping stone towards completion. Gender disparity in completion rates tends to be larger than in enrolment rates for disadvantaged groups. But there is also a big difference in gender disparity between completing an education cycle on time or not, especially in sub-Saharan Africa. Global SDG indicator 4.1.2 is the completion rate for those 3 to 5 years above graduation age ('timely' completion) but in sub-Saharan Africa, more than in any other world region, many children and young people complete each cycle even later than that ('ultimate' completion).

In primary education, there is gender parity in both the timely and ultimate completion rates, globally, while the same is true in Central and Southern Asia, which is used here as a reference region. But in sub-Saharan Africa since 2013, girls have been far more likely than boys to complete primary school on time. In contrast, girls are still less likely to ultimately complete primary school than boys: 96 girls complete for every 100 boys who do so (**Figure 4a**).

In lower secondary education, there is gender parity in both timely and ultimate completion rates, globally, and also in Central and Southern Asia since 2020. In sub-Saharan Africa, gender parity in timely completion has almost been achieved, but girls are at a much bigger disadvantage in ultimate completion: 85 girls complete for every 100 boys who do so. This means that if girls start school on time and do not repeat grades, so that they are not too old for their grade, they are currently almost as likely as boys to complete lower secondary school as boys. But because of the problems of late entry and repetition, if they reach the age of 15 and have still not reached the end of lower secondary school, they are more likely to drop out (**Figure 4b**).

In upper secondary education, gender parity was achieved globally in timely completion in 2010 but by 2018 there was reverse disparity and as of 2020 there were 96 young men completing upper secondary school for every 100 young women. Parity was achieved in ultimate completion in 2013 and has been maintained. But it must be noted that that this is an average of different tendencies. Of 163 countries with data, only 24% achieved parity in 2020, while 27% had a disparity at the expense of young women and 49% a (smaller) disparity at the expense of young men.

In Central and Southern Asia, for every 100 young men who completed upper secondary school on time there were 68 young women in 2000 increasing to 93 in 2020. There is no difference in disparity between timely and ultimate completion. Sub-Saharan Africa started from a more equal position (75 young women completed for every 100 young men in 2000) but progressed at half the rate (87 young women for every 100 young men in 2020) and has fallen behind Central and Southern Asia. On the positive side, the rate of progress was twice as fast in 2008–20 than in 2000–08. But gender disparity is much higher in the ultimate completion rate: 78 young women complete for every 100 young men who do so (**Figure 4c**).

Young women who do not finish upper secondary school on time are more likely to leave school early, under pressure to marry and have children, while young men can afford to persevere with their education for a little longer to obtain the upper secondary education certificate. There has been no progress at all in closing this gap in the past 20 years. By contrast, this problem is not present at all in Central and Southern Asia, which is one of the reasons that helps explain the faster progress of the region in closing the gender gap.

FIGURE 4:

In sub-Saharan Africa, girls are relatively more likely than boys to complete each school cycle on time

Adjusted gender parity index of the timely and ultimate completion rate, 2000–20

a. Primary

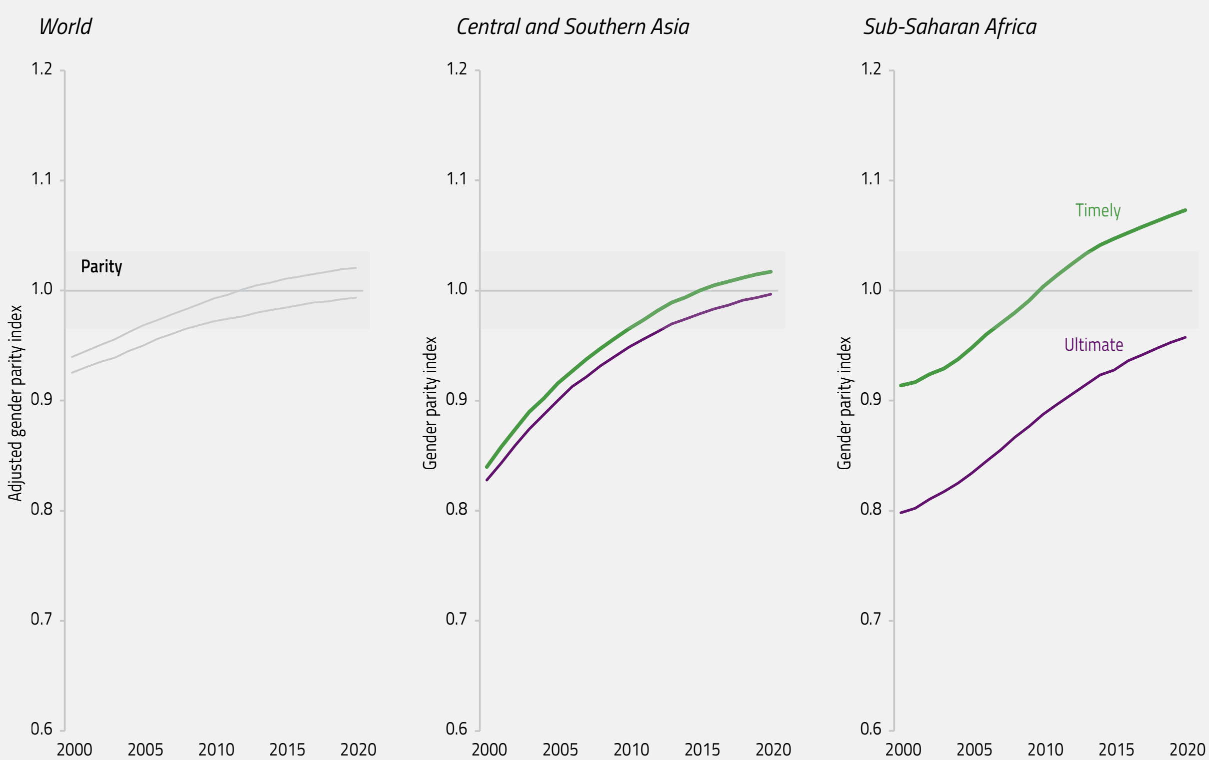
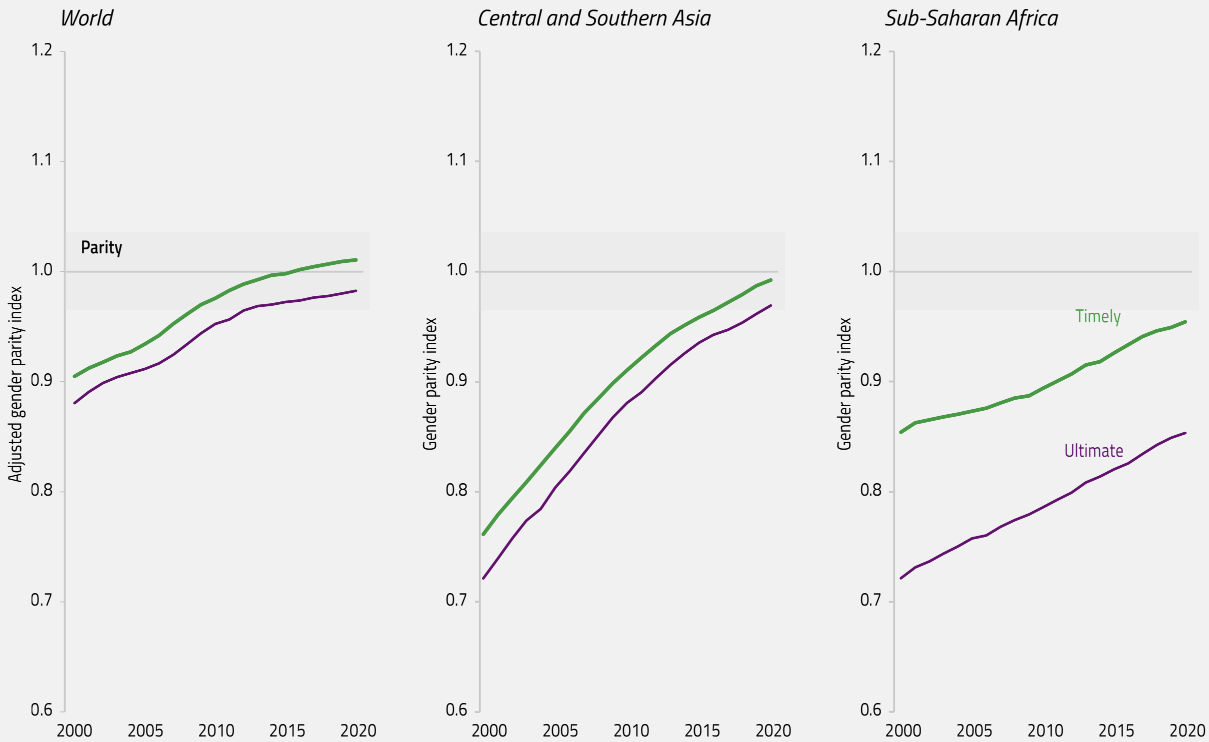
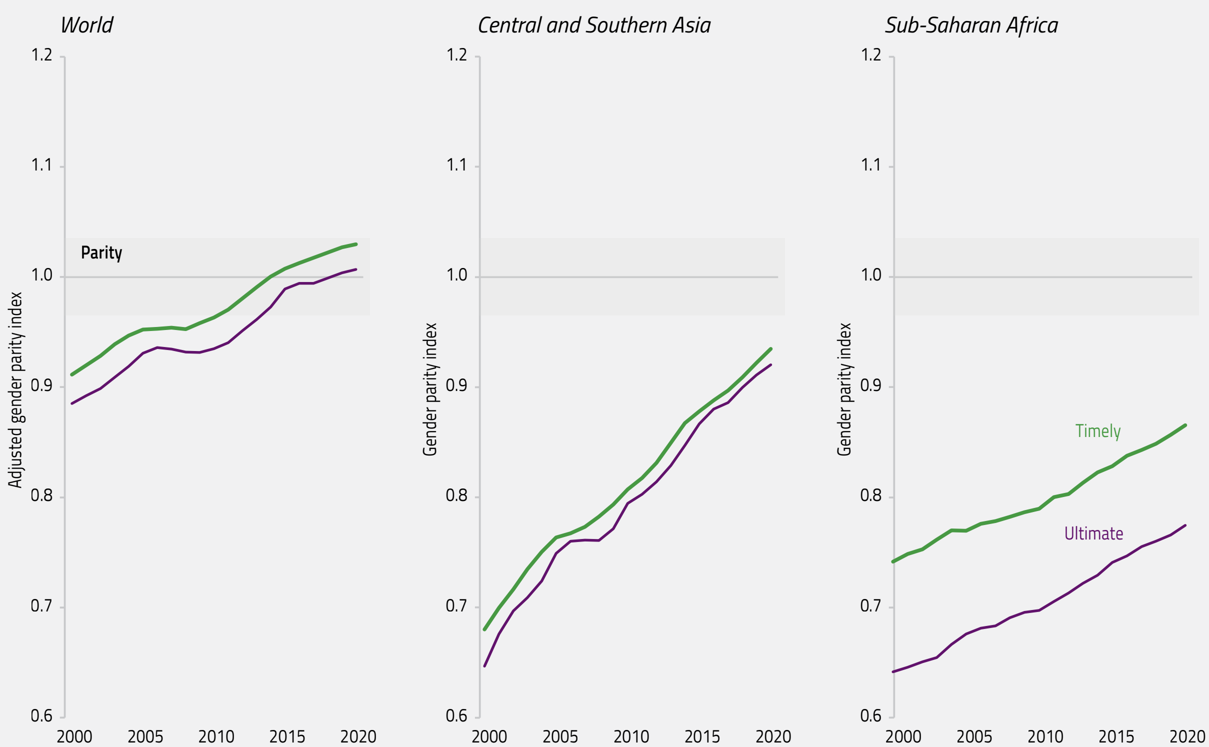


FIGURE 4 CONTINUED:

b. Lower secondary



c. Upper secondary



Source: VIEW database.

COUNTRIES FOLLOW VARIOUS TRAJECTORIES TOWARDS OR AWAY FROM PARITY

The second point to note is that countries' trajectories depart from the global trend. Globally, the gender gap in the out-of-school rate among youth of upper secondary school age fell from four percentage points in 2000 to zero in 2020. But it is possible to observe six patterns. Three have a starting point of an initial gap in favour of men, which remained constant (e.g. Guinea), declined (e.g. Sierra Leone) or reversed (e.g. Cambodia). One shows the maintenance of parity throughout (e.g. Ecuador). The other two start with an initial gap in favour of women, which declined (e.g. Mongolia) or remained constant (e.g. the Philippines) (**Figure 6**).

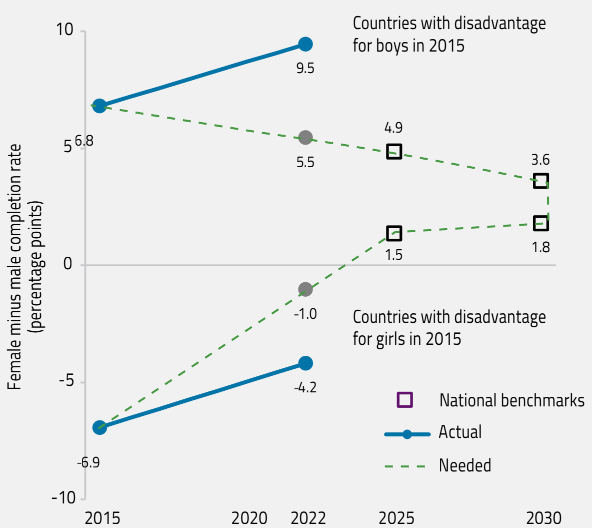
BOX 3:

The gender gap in secondary completion is the only equity-oriented SDG 4 benchmark indicator

FIGURE 5:

Countries' progress in closing the gender gap in secondary completion depends on their starting points

Countries' actual and needed progress to achieve their national benchmarks in the gender gap in upper secondary completion, by starting point 2015–22



Source: UNESCO (2024).

In 2015, countries agreed in the Education 2030 Framework for Action, which is the roadmap for achieving SDG 4, to establish "appropriate intermediate benchmarks (e.g. for 2020 and 2025)" considering them as "indispensable for addressing the accountability deficit associated with longer-term targets" (UNESCO, 2015). The UNESCO Institute for Statistics (UIS) and the *Global Education Monitoring Report*, which are jointly mandated by the Education 2030 Framework for Action to monitor progress towards SDG 4, have been helping countries to fulfil the commitment to set national SDG 4 benchmarks, defined as national targets for selected indicators to be achieved by 2025 and 2030.

In 2019, the Technical Cooperation Group (TCG) on SDG 4 Indicators endorsed six SDG 4 benchmark indicators and decided that a seventh indicator should focus on equity. Following further deliberations in 2020–21, the TCG decided on the gender gap in upper secondary completion rates as the seventh benchmark indicator. Note that the indicator is not the (relative) gender parity index (completion rate female / completion rate male) but the (absolute) gender gap (completion rate female – completion rate male) because TCG members felt that the gap would be more transparent.

While 70% of countries have submitted a national target for the upper secondary completion rate, only 36% of countries have submitted a national target for the gender gap in upper secondary completion, the lowest submission rate of all benchmark indicators. There is no difference between the initial conditions of countries that did and did not submit national targets. The only plausible assumption is that countries are not used to the idea of setting an equity target and, faced for the first time with the task, they found it difficult to set a target, knowing they are unlikely to achieve parity.

This is reflected in the results of the second SDG 4 Scorecard, the annual monitoring report on progress towards the national SDG 4 benchmarks (UNESCO, 2024). Reflecting the long-term trend towards more young women completing secondary school, countries in which fewer young women than men completed upper secondary school in 2015 (on average a 6.9 percentage point gap) had reduced the gap to 4.2 percentage points by 2022, although the gap should have been just 1.0 percentage point if they had been on track to achieve their target. In contrast, countries in which fewer young men than women completed upper secondary school in 2015 (on average a 6.8 percentage point gap) saw their gap increase to 9.5 percentage points, although the gap should have been 5.5 percentage points if they had been on track (**Figure 5**). In fact, the gender gap is the benchmark indicator with the largest percentage of countries moving away from their target.

FIGURE 6:
Six country patterns can be observed in the evolution of the gender gap in upper secondary out-of-school rates
Upper secondary out-of-school rate, by sex, 2000–20

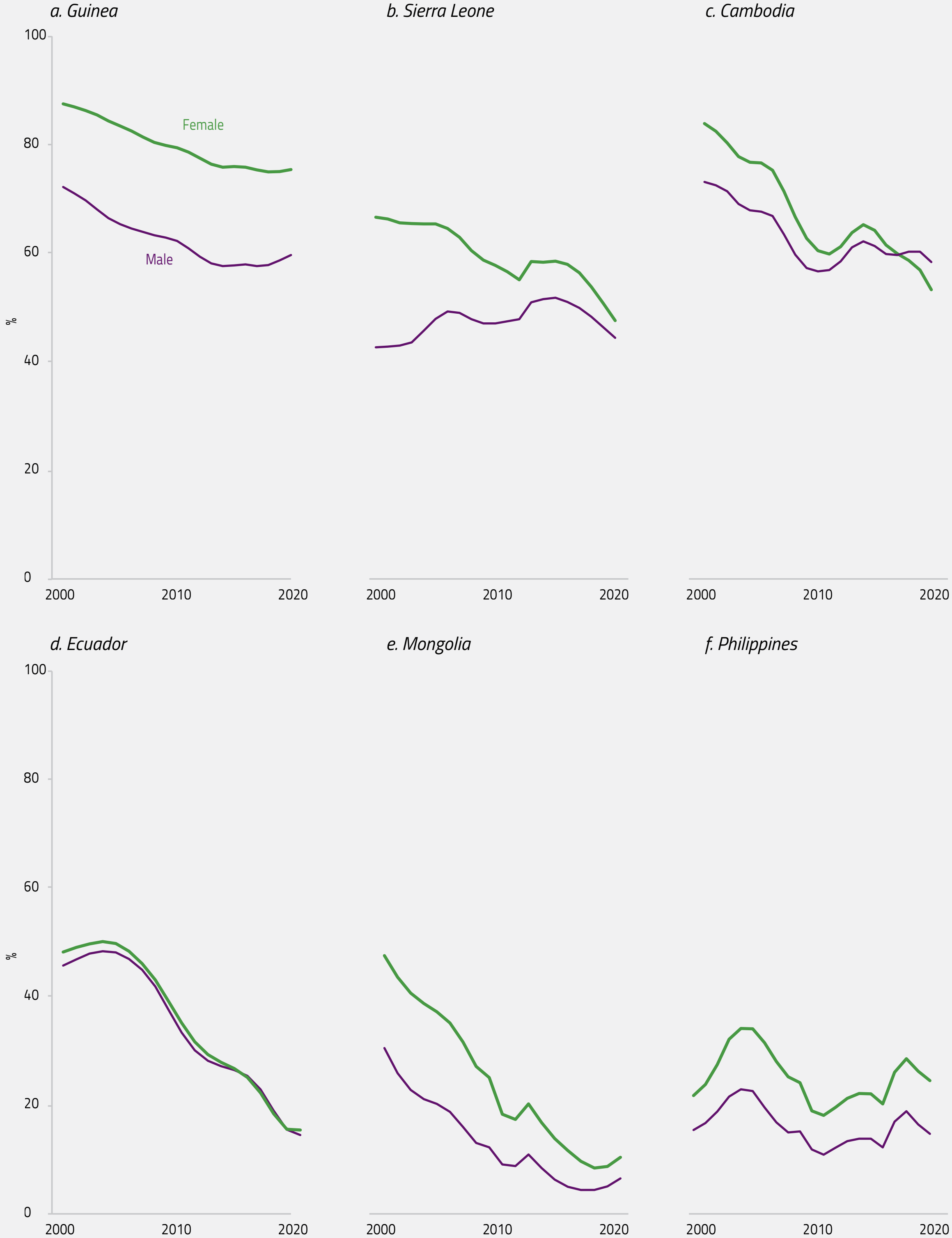


FIGURE 6 CONTINUED:

Initial gap in favour of men			Initial parity	Initial gap in favour of women	
Constant	Decreasing	Reversing	Constant	Decreasing	Reversing
Benin, Cameroon, C. A. R, Chad, Côte d'Ivoire, Eritrea, Ethiopia, Guinea-Bissau, Iraq, Mali, Mozambique, South Sudan, Togo, Yemen, Zambia	Angola, D. R. Congo, Türkiye	Bhutan, Comoros, Gambia, India, Nepal, Viet Nam	Algeria, Armenia, Bolivia, Haiti, Kenya, Mexico, Rwanda, Saudi Arabia, South Africa	Costa Rica, Lao PDR, Saint Lucia, St Vincent/Grenad., Suriname, Trinidad/Tobago, Uruguay	Cabo Verde, Honduras, Jamaica, Malaysia, Mauritius, Philippines, Thailand, Venezuela, B. R.

Source: VIEW database.

PARITY FOR SOME DOES NOT MEAN PARITY FOR ALL

The third point about interpreting parity index values is that they only measure average disparity. While the situation of girls and young women has improved rapidly in many countries, some are trapped in pockets of disadvantage due to location and poverty – but also due to other social and cultural characteristics. For instance, in Mozambique, there are 73 young women in school for every 100 young men. But, while there is gender parity in urban areas, in rural areas there are 53 young women in school for every 100 young men. In contrast, in the relatively few countries where young men are on average at a disadvantage, their disadvantage tends to be higher in rural areas, such as in Mongolia and Palestine (**Figure 7a**).

The disparity is even more exacerbated in terms of wealth. In a large number of low- and lower-middle-income countries, including the Democratic Republic of the Congo, Nigeria and Pakistan, there is gender parity in school attendance among the richest youth but substantial disparity among the poorest youth. In Côte d'Ivoire, there are 72 young women in school for every 100 young men but only 22 poor young women in school for every 100 poor young men. Again, in the few countries where young men are at a disadvantage, their disadvantage tends to be higher among the poorest, such as in Bangladesh and Lesotho (**Figure 7b**).

GENDER DISPARITY IN LEARNING VARIES AMONG AVERAGE AND TOP STUDENTS

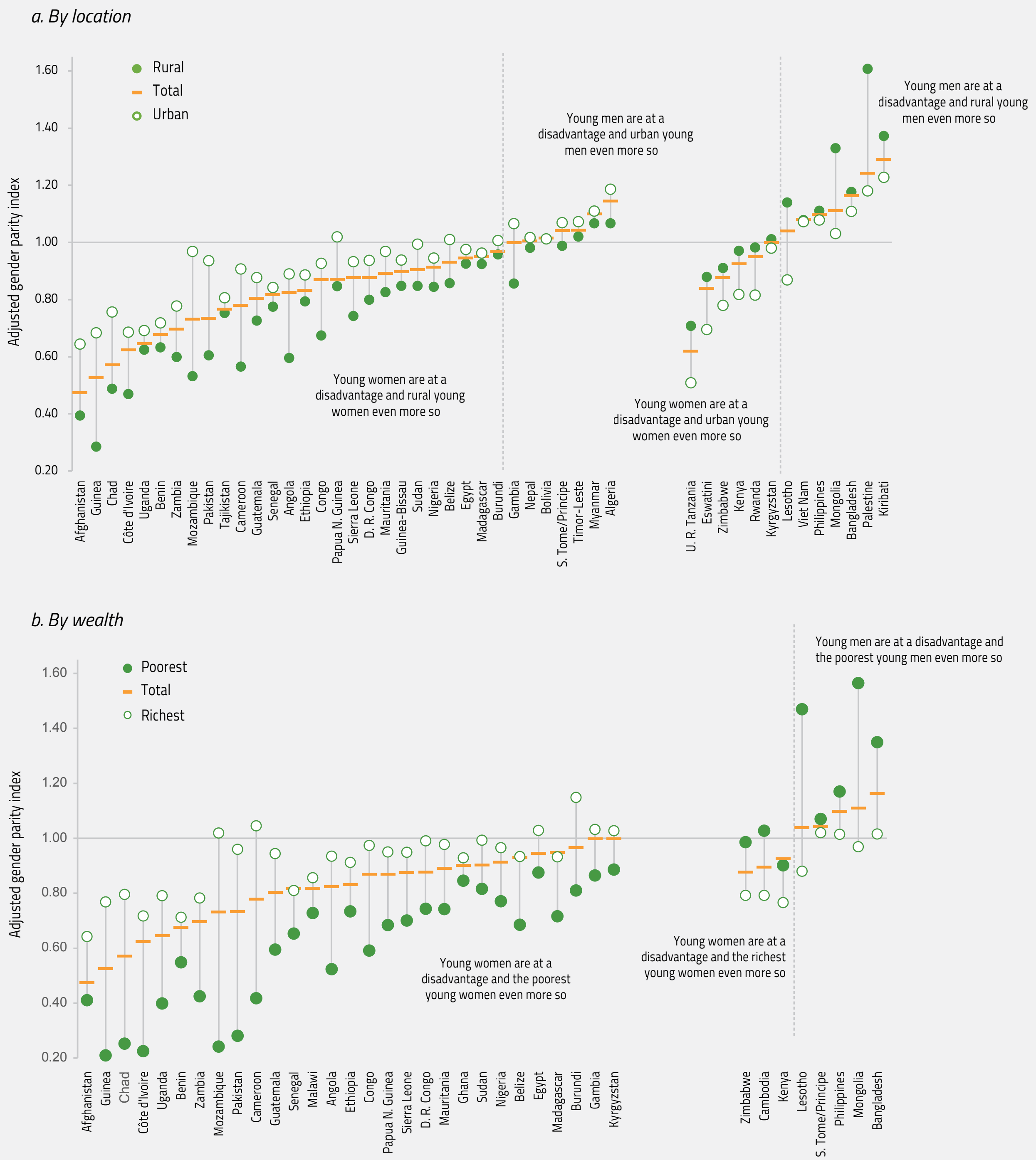
While girls and young women still face hurdles in education access and completion in many poor countries, gender gaps in learning outcomes are of a different kind. In reading, among 97 countries with data on the end of primary and of lower secondary education in 2016–19, only two low-income countries had a tiny gap favouring boys: Chad and the Democratic Republic of the Congo. In the other 95 countries, the share of girls with minimum proficiency was an average of 10 percentage points higher than the share of boys. Globally, for every 100 proficient boys, there are 115 proficient girls in reading at the end of lower secondary education.

Boys have a small advantage over girls in mathematics in primary education, but this is reversed in lower secondary education. In the 2019 Trends in Mathematics and Science Study, the share of grade 4 boys with minimum proficiency exceeded that of girls by 1.4 percentage points in 30 upper-middle and high-income countries. But by grade 8, it was girls that had a 1.4 percentage point advantage over boys (**Figure 8a**). In science, girls already have an advantage in grade 4 (by 1.9 percentage points) which more than doubles by grade 8 (4.3 percentage points) (**Figure 8b**).

FIGURE 7:

Young women in poor and rural households tend to be educationally more disadvantaged than the average learner

Gender parity index of the attendance rate among youth of upper secondary school age, low- and lower-middle-income countries, 2014–19

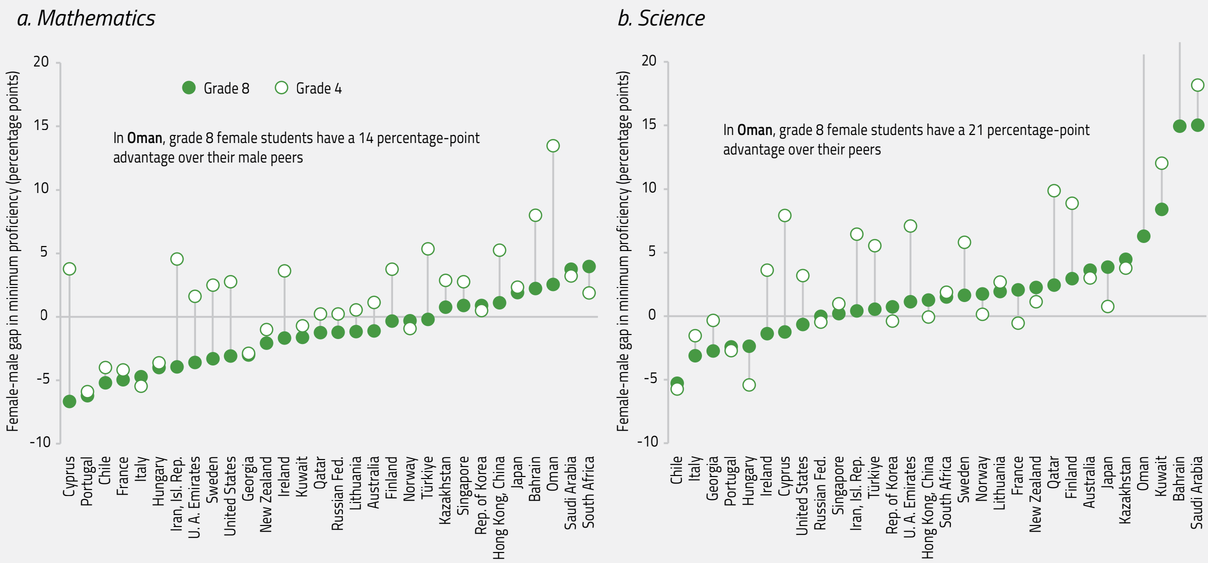


Source: WIDE database.

FIGURE 8:

Girls' performance in mathematics and science is improving relative to boys' as they move from primary into lower secondary

Female–male gap in share of students achieving minimum proficiency level in mathematics and science, grade 4 and grade 8, 2019



Source: VIEW database.

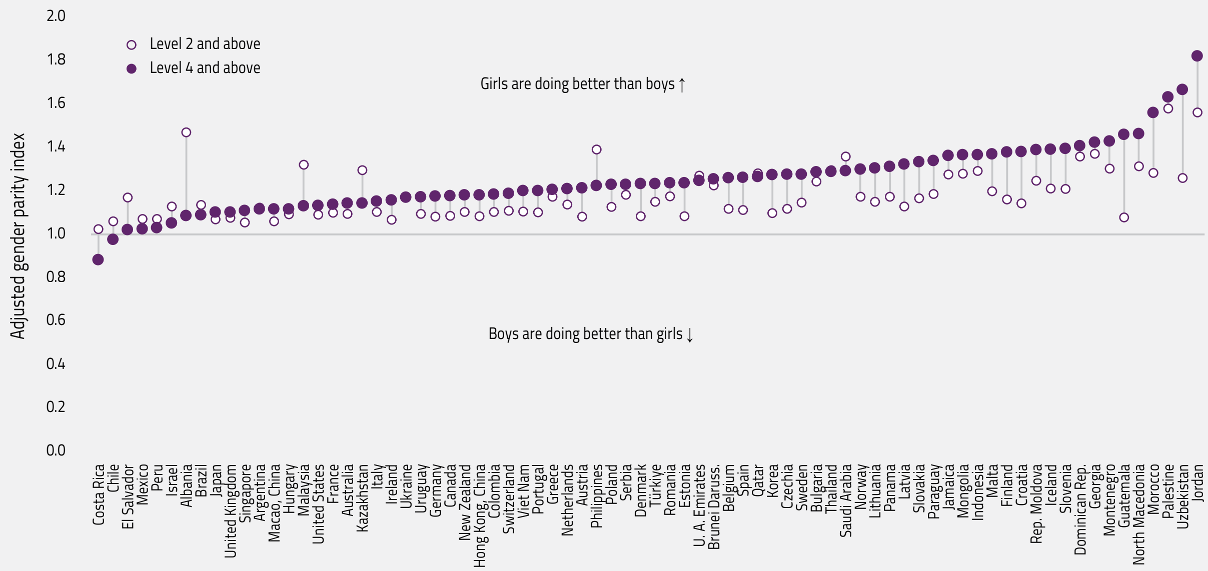
However, it should be noted that these gaps relate to the achievement of minimum proficiency, as suggested by data from 76 education systems that took part in the 2022 PISA survey. In reading, the adjusted gender parity index in the median country is higher among girls at a high level (Level 4 and above) of performance (1.23) than at the minimum level (1.15) (**Figure 9a**). But boys tend to have a considerable advantage over girls in science and mathematics at the higher end of performance. In science, the median adjusted gender parity index is 1.04 at the minimum level but 0.92 at the high level (**Figure 9b**). In mathematics, there is gender parity (1.00) at the minimum level of proficiency, but the adjusted gender parity index is only 0.75 at the high level of proficiency (**Figure 9c**). In the Dominican Republic and El Salvador, boys are five times more likely to be among the top performers, although this result should be put in the context that only 0.1% to 0.2% of students achieved that level.

FIGURE 9:

The gender gap differs at average and top performance levels

Adjusted gender parity index in share of students achieving minimum and 'high' proficiency level, 15-year-olds, 2022

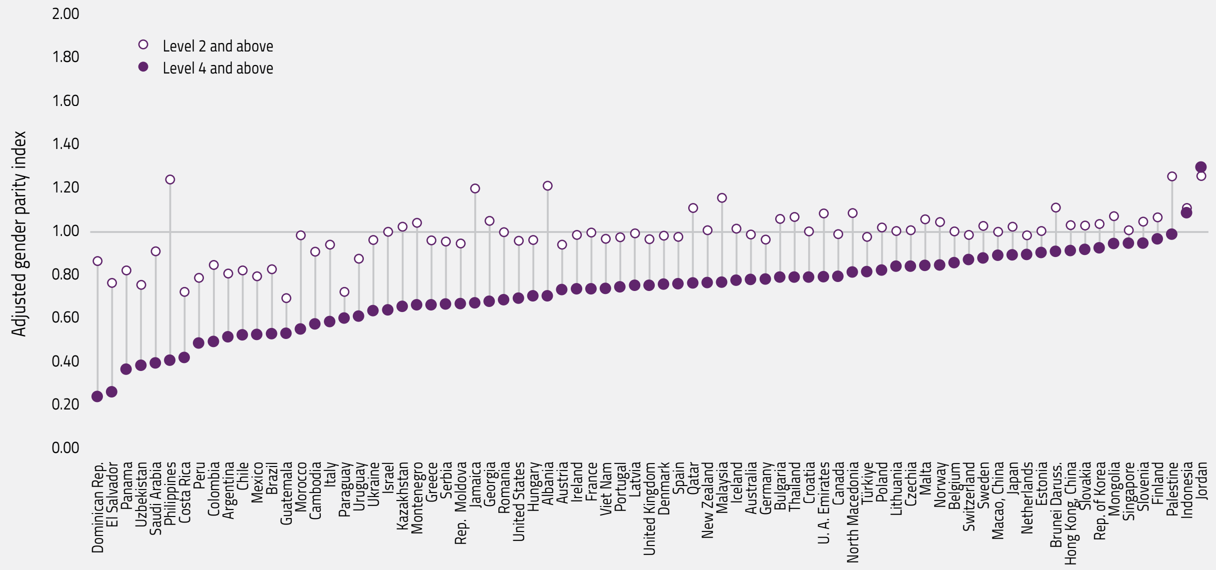
a. Reading



b. Science

FIGURE 9 CONTINUED:

c. Mathematics



Source: WIDE database, GEM Report team analysis of 2022 PISA data.

THE TERTIARY EDUCATION PARTICIPATION GENDER GAP IS GROWING

Indicator 4.3.2 is the gross enrolment ratio for tertiary education. It divides the number of people enrolled in tertiary education, regardless of age, by the number of people within five years of the standard age for upper-secondary completion (usually 19 to 23 years old). However, the indicator does not account for differences in the duration of programmes between countries (for example, whether a bachelor's degree typically takes three or five years). Moreover, the indicator does not distinguish between different levels of tertiary education. For example, two countries with similar enrolment ratios might have quite different profiles, with one having far more people studying in short-cycle or long-cycle programmes or even in postgraduate degrees.

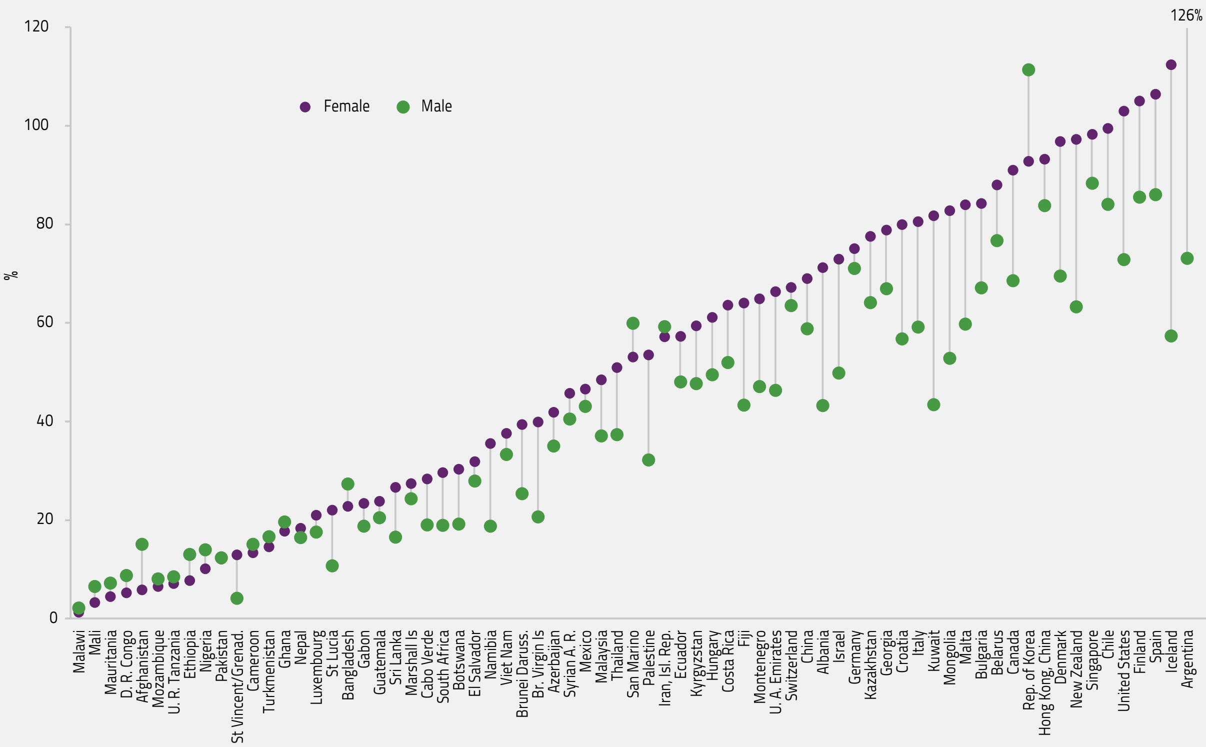
Global enrolment in tertiary education grew over the previous decade, but at a slower pace after 2015: the gross enrolment ratio increased from 29% in 2010 to 37% in 2015, but only to 40% five years later. Gross enrolment ratios range from below 1% in South Sudan to over 150% in Greece, where many are still enrolled to maintain certain social benefits even though they are not actually attending. At the lower end, 16 countries have a female gross enrolment ratio below 10%, all of which are in sub-Saharan Africa except Afghanistan, even before the Taliban government banned tertiary education for women.

In most countries, females are more likely than males to be enrolled in tertiary education. In 2020, the gross enrolment ratio for women was 43% compared to 37% for men. Of the 146 countries with data, 106 have a gap in favour of females and 30 – 22 of which are in sub-Saharan Africa – have a gap in favour of males. The higher the rate of tertiary enrolment, the more likely there is to be a gap in favour of females. Of the 50 countries with the highest enrolment ratios, only the Republic of Korea has a sizeable gap in favour of males, compared to 47 countries with a sizeable gap in favour of females (**Figure 10**).

FIGURE 10:

There is a large gender gap in tertiary education participation

Gross enrolment ratio for tertiary education, by sex, 2018–22



Source: UIS database.

Yet the gender gaps are in the opposite direction in terms of internationally mobile students. The inbound mobility rate, which is the number of students from abroad studying in a country expressed as a percentage of total tertiary enrolment in that country, shows that male students are more likely to travel for studies. Globally, student mobility increased from 2.2% in 2015 to 2.7% in 2020 before experiencing a decline due to COVID-19. Mobility increased in all regions except sub-Saharan Africa. But the gender parity index of mobile students fell globally from 0.89 in 2010 to 0.85 in 2015 and 0.82 in 2020. It was even lower in Europe and Northern America (0.77) and especially Northern Africa and Western Asia (0.55). The only region where female students are more mobile than male students is sub-Saharan Africa (**Figure 11**).

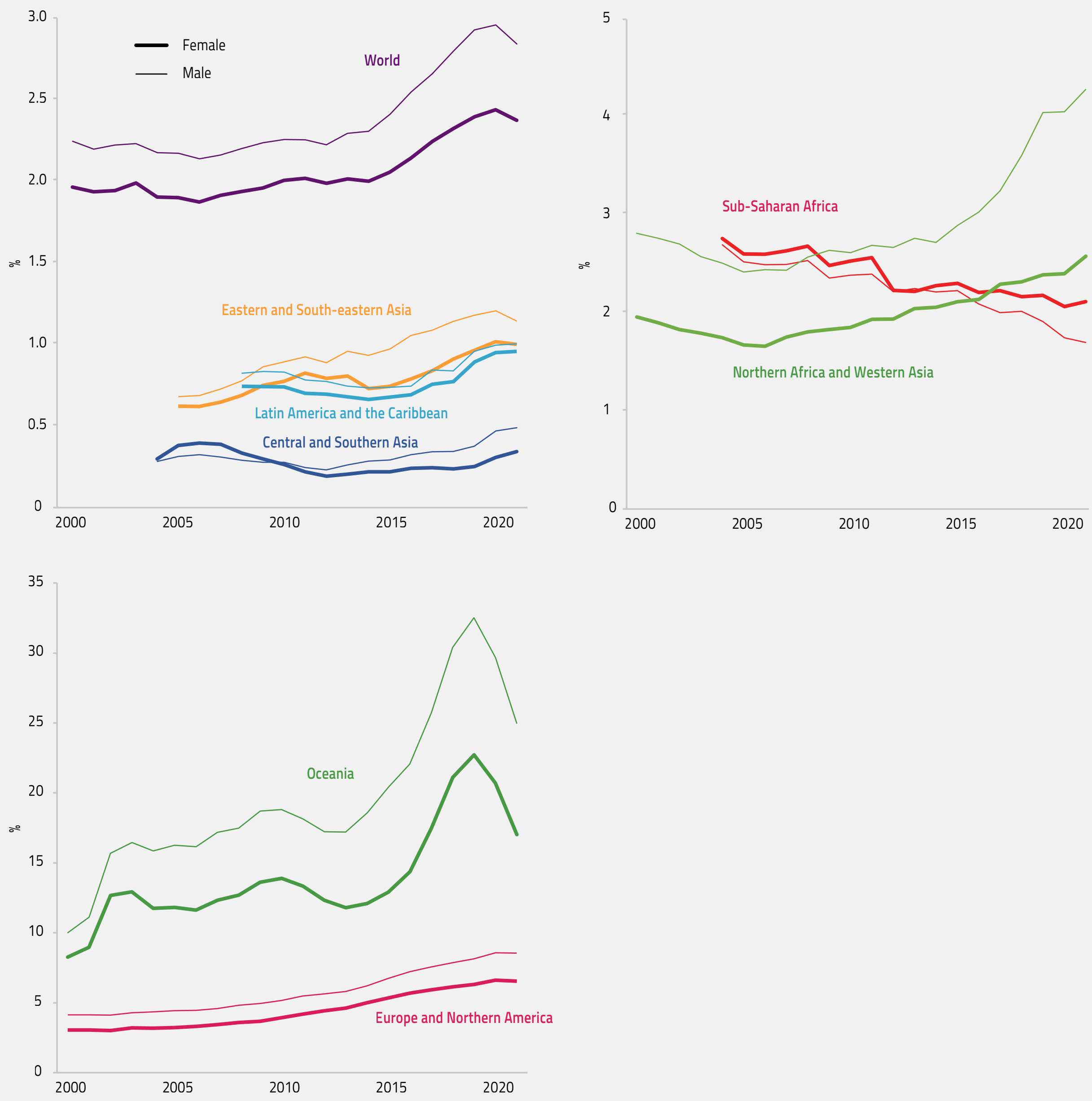
THERE IS A GENDER GAP IN TVET BUT NOT IN ADULT EDUCATION AND TRAINING

Indicator 4.3.3, which measures the participation rate in technical-vocational education among 15- to 24-year-olds, regardless of whether they are at the secondary, post-secondary, non-tertiary or tertiary levels, shows a contrasting situation. Unlike indicator 4.3.2 on tertiary education, which counts participation regardless of age, this indicator only counts participation among youths in this particular age range. In contrast to tertiary education, the gender gap in technical-vocational education is smaller and tends to favour males. Of the 146 countries with data, 40 have a sizeable gap in favour of males (in excess of 3 percentage points) in contrast to just 3 countries (Curaçao, Israel and Seychelles) in favour of females. Across countries, participation in technical-vocational programmes ranges from zero to 36%. The lowest participation rates (less than 10%) are found primarily in the Caribbean, the Pacific and sub-Saharan Africa. The highest rates (more than 25%) are found almost exclusively in Europe, the exceptions being the Plurinational State of Bolivia, Seychelles, Singapore and Uzbekistan.

FIGURE 11:

More men than women tertiary students are internationally mobile

Inbound mobility rate, region and by sex, 2000–21



Source: UIS database.

Global indicator 4.3.1 focuses on the participation rate of youth and adults in formal and non-formal education and training in the previous 12 months. While participation in formal education and training can be measured by asking both providers and beneficiaries, non-formal education and training opportunities can only be estimated systematically by asking those who benefit from them. The data that inform this indicator, therefore, primarily come from labour force surveys compiled by the International Labour Organization and analysed by the UNESCO Institute for Statistics.

For adults aged 25 to 54, the median participation rate in formal and non-formal education and training across 115 countries with recent data is 3%, ranging from 2% in low- and lower-middle-income countries to 3% in upper-middle-income countries and 7% in high-income countries. In Europe, the median is 8%; all countries with participation rates above 10% are in this region.

Globally, there is gender parity in participation rates with males at 3.1% and females at 3%. Of the 113 countries with data by sex, only 6 have a gender gap of more than 5 percentage points, and in all cases, it is in favour of females. All but one of them are located in northern Europe (Denmark, Estonia, Finland, Iceland and Sweden, which has the largest gap of 14 percentage points); the other country is the Dominican Republic.

GENDER GAPS IN ADULT LITERACY ARE ALSO DISAPPEARING

Globally, the youth literacy rate increased from 87% in 2000 to 91% in 2015, but only by 0.8 percentage points in the five years to 2020. The number of illiterate youth fell from 107 million in 2015 to 99 million in 2020, of which 36 million were in Central and Southern Asia and 49 million were in sub-Saharan Africa. Women make up 56% of all illiterate youth.

FIGURE 12:
What little progress is observed in adult literacy is the result of more young, educated people in the population
Literacy rate by age group and sex, two waves of household surveys, selected countries

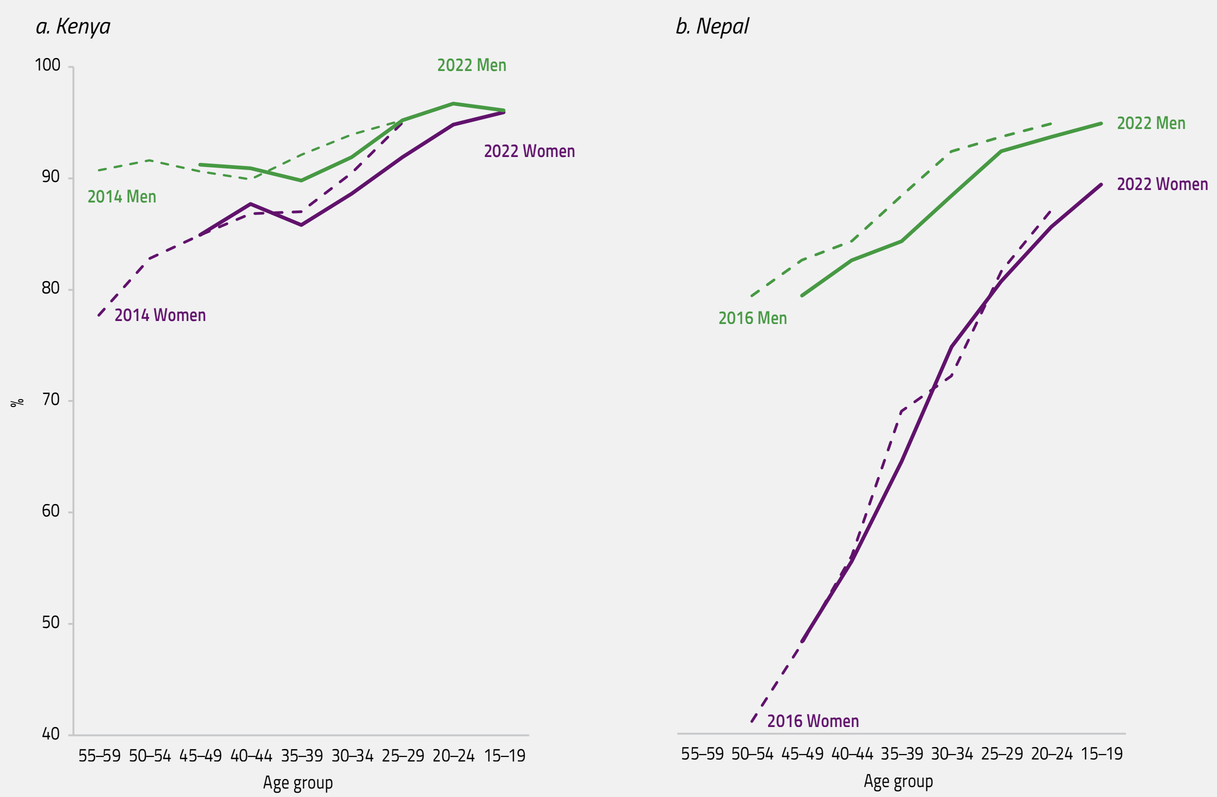
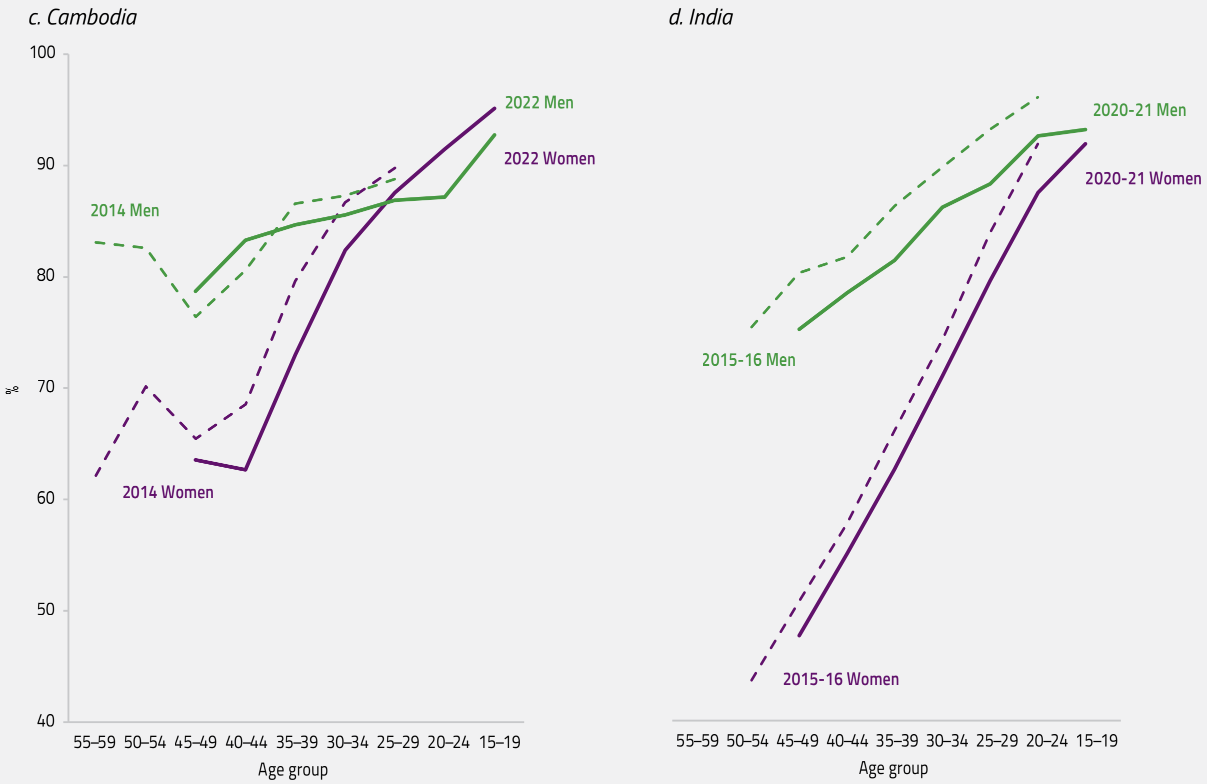


FIGURE 12 CONTINUED:



Notes: For every country, the continuous line represents the literacy rate of each age group by sex in the most recent survey. The dashed line represents the literacy rate of each age group by sex in the earlier survey but has been shifted to the left to facilitate comparisons. For instance, the dashed line for the 2015–16 DHS in India has been shifted by 5 years to the left so that the literacy rate of 15- to 19-year-olds in 2015–16 corresponds to the literacy rate of 20- to 24-year-olds five years later, in 2020–21. The dashed line has also been shifted by 5 years in Nepal (where the two survey rounds are 6 years apart) and by 10 years in Cambodia and Kenya (where the two survey rounds are 8 years apart).

Source: DHS country Final Reports.

The adult literacy rate, for people aged 15 to 64 years, has increased from 81% in 2000 to 86% in 2015 and to 87% in 2020, an increase of just 1.2 percentage points in five years. The number of illiterate adults dropped from 783 million in 2015 to 763 million in 2020, of which 367 million were in Central and Southern Asia and 205 million were in sub-Saharan Africa, where the number increased by 9 million. Women are 63% of all illiterate adults.

These estimates are based to a large extent on the misleading assumption that having completed four years of education is equivalent with being literate, which does not hold in many poor countries. Self-reporting of the ability to read and write is still being used in some population censuses and labour force surveys. But it is also problematic. The UIS has been incorporating into its literacy estimates information from household surveys, notably the Demographic and Health Survey (DHS) and the Multiple Indicator Cluster Survey (MICS), which include a rudimentary but direct measure of the ability to read a simple sentence. One disadvantage is that these surveys only sample adults aged 15 to 49 years, and usually only women.

Even so, household surveys shed light on the process by which adult literacy rates change. There are two potential mechanisms in operation. First, as younger, more educated cohorts replace older, less educated cohorts, the adult literacy rate increases by virtue of the changing population composition. Second, adult literacy rates can also change through adult literacy programmes. However, data from two DHS rounds in selected low and middle-income countries show little evidence that the latter mechanism is at play: literacy programmes, even when effective, rarely reach the scale required to have a visible impact at the population level.

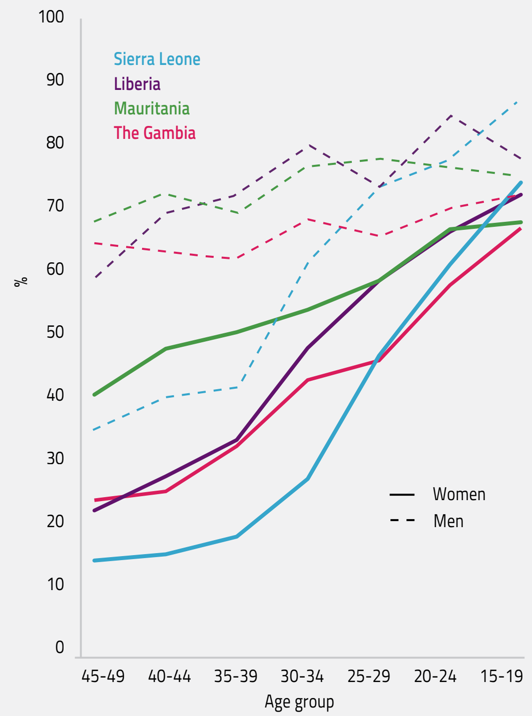
In India, two successive rounds of the DHS were carried out five years apart from each other, in 2015–16 and in 2020–21. If adult education programmes were effective and at scale, then the literacy rates of, say, the cohort of 30- to 34-year-old women in 2020–21 should be higher than the literacy rates of the cohort of 25- to 29-year-old women in 2015–16. But in India, as in Cambodia, Kenya and Nepal, the literacy rates of these cohorts remain the same or have even decreased somewhat. Improvement in the literacy status of women has been exceptionally fast. In India, 46% of 45- to 49-year-old women but 90% of 15- to 19-year-old women were literate in 2020–21, closing a gender gap of almost 30 percentage points in 30 years. In Cambodia, women's literacy rates exceed those of men in the youngest cohorts (**Figure 12**).

The cohort analysis also documents differences in countries' trajectories. For instance, it shows the devastating impact of the Cambodian genocide: adults in their 40s have lower literacy rates than their peers in their 50s. It also shows that countries in the same region can achieve different rates of progress. For example, in western Africa in Sierra Leone, where some of the lowest literacy rates in the world are found, female literacy rates have increased exponentially: in 2019, only 18% of 35- to 39-year-old women but 74% of 15- to 19-year-old girls could read. Male literacy rates have also increased rapidly. By contrast, male literacy rates have progressed very slowly in the Gambia, Liberia and Mauritania. In Gambia, 64% of 45- to 49-year-old men and 72% of 15- to 19-year-old young men are literate, an increase of just 8 percentage points in 30 years. In Liberia and Mauritania, youth literacy rates appear to have even fallen in the latest five-year period (**Figure 13**).

FIGURE 13:

Literacy rates for adult men have stagnated in The Gambia, Liberia and Mauritania

Literacy rate by age group and sex, selected western African countries, 2019–21



Source: DHS Country Final Reports.

GIRLS NEED SEPARATE SANITATION FACILITIES IN SCHOOLS

In the countries still furthest behind from achieving gender parity in access to education, one of the most important issues is the availability of single-sex sanitation facilities. Separate bathrooms for boys and girls are often a prerequisite for girls to attend school because of concerns over their safety. Over 20% of primary schools in Central and Southern Asia and in Eastern and South-eastern Asia lack functional single-sex bathrooms; in Mali and Togo, they are lacking in 83% and 94% of schools, respectively.

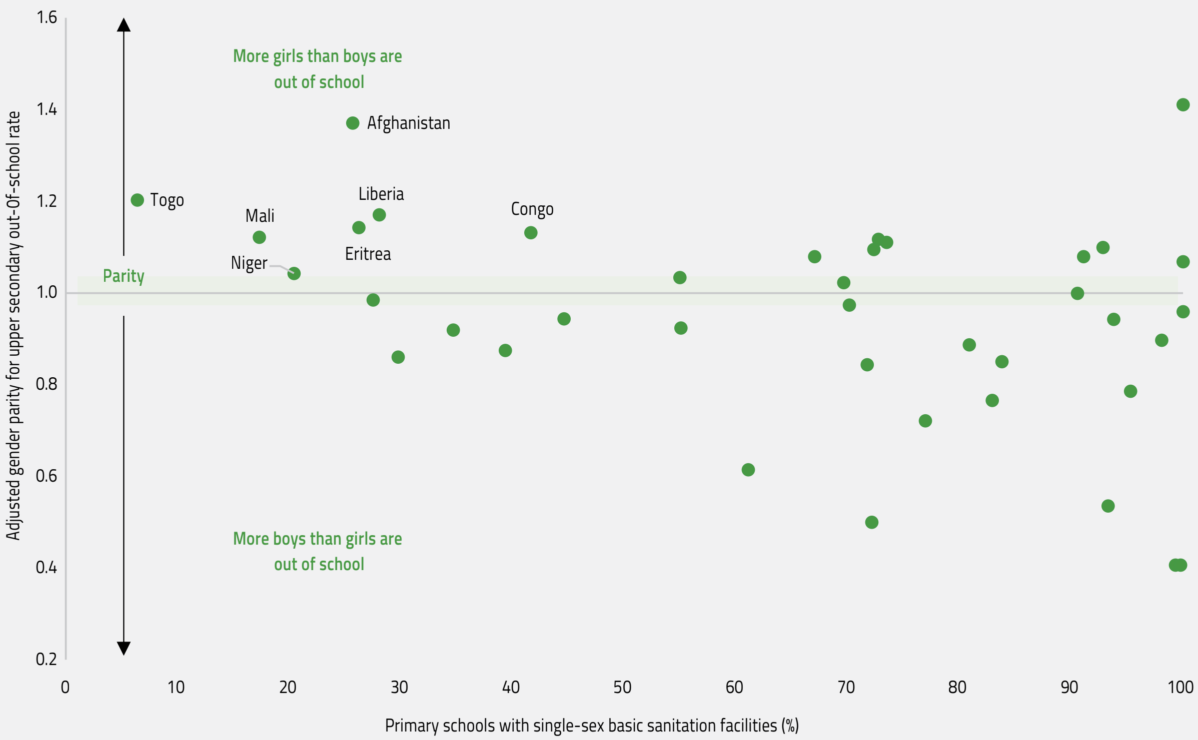
Single-sex bathrooms are more common in secondary than in primary schools. In Burundi, for example, 35% of primary and 100% of upper secondary schools had single-sex bathrooms in 2018. But this might be too late for some girls, given very high levels of over-age enrolment: that year, 31% of primary school students were at least 2 years over-age for their grade. A lack of menstrual hygiene facilities, stigma and stress lead many girls to missing up to one week of school a month, increasing the chances of falling behind and dropping out (UNICEF, 2023a).

A lower share of primary schools with single-sex bathrooms is associated with a higher out-of-school rate for girls than for boys in upper secondary education (**Figure 14**). This negative relationship may also reflect broader gender bias. In Afghanistan, the lack of single-sex bathrooms in three quarters of primary schools in 2018 may have been indicative of an overall lack of priority for gender equality in education, even before the Taliban takeover in 2021.

FIGURE 14:

The availability of single-sex toilets in primary education is associated with relatively lower out-of-school rates for girls of secondary school age

Share of primary schools with single-sex sanitation facilities and adjusted gender parity index for out-of-school rates of upper secondary youth in low- and lower-middle-income countries, 2016–22



Source: UIS database (single-sex sanitation facilities) and VIEW database (out-of-school).

WOMEN DOMINATE THE TEACHING PROFESSION BUT THERE IS LARGE VARIATION

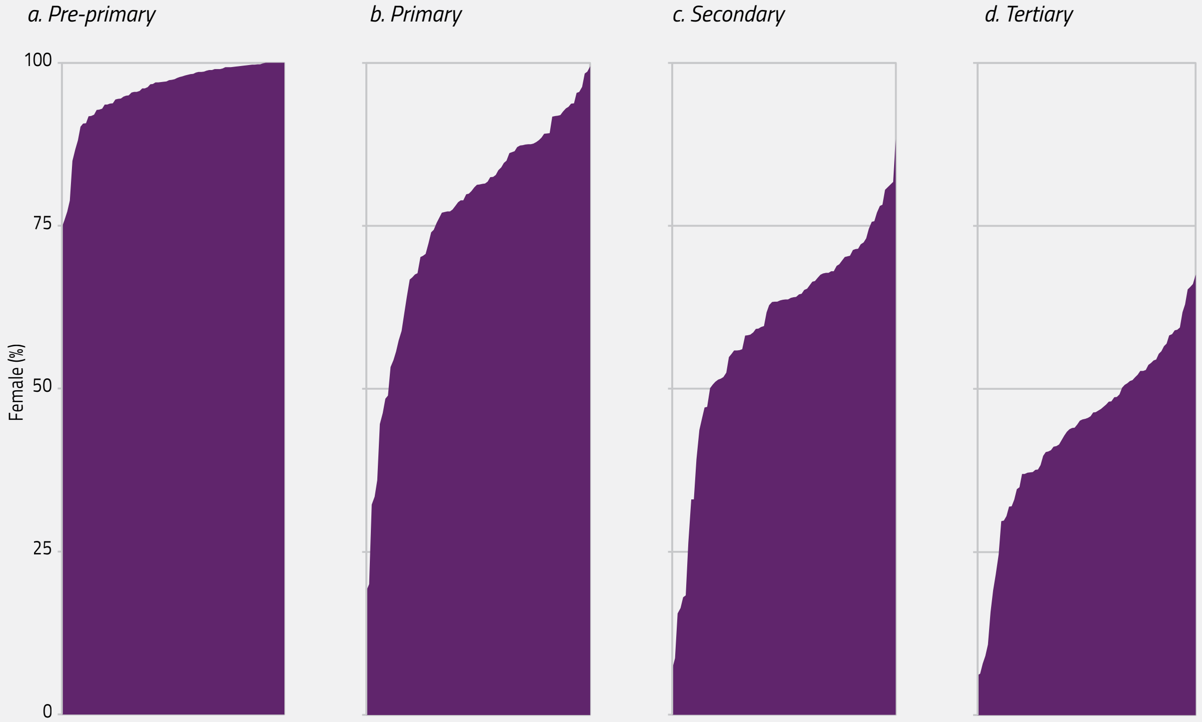
Globally, women are overrepresented in the teaching force. Among 84 countries with data at all four levels of education, the average share of educators who are female are 96% in pre-primary education, 76% in primary education, 59% in secondary education and 44% in tertiary education. Women are the majority in 89% of countries in primary and 83% of countries in secondary education (**Figure 15**).

But in some, mostly central and western African countries, women are still underrepresented. For instance, in Chad and Togo just 1 in 5 primary school and 1 in 10 secondary school teachers are female. In the Democratic Republic of the Congo, just 6% of university teaching staff are female. Countries where the majority of those teaching in universities are female are commonly in the Caribbean (e.g. British Virgin Islands and Cuba), the Caucasus (e.g. Armenia and Azerbaijan), Central Asia (e.g. Kazakhstan and Kyrgyzstan) and Eastern Europe (e.g. Albania and Belarus).

FIGURE 15:

The majority of teachers in primary and secondary education are women

Share of female teachers, by education level, 2020–22



Note: Each figure shows the share of female teachers. For each level of education, countries are ordered from the one with the lowest to the one with the highest share of female teachers.

Source: UIS database.

Mahajanga, Boeny - Rouweidah and other child using the school computer to expand her knowledge, computer with internet access, at ease in their environment. Madagascar.

Credit: © UNICEF/UNI441157/Andriantsoarana

Technology affects girls' education opportunities and outcomes

The 2023 *Global Education Monitoring Report* presented the ways in which information and communication technology (ICT), especially digital technology, is shaping education. Technology can bring education opportunities to groups who are otherwise hard to reach, for instance in crisis situations (**Box 4**). It can lift barriers to accessing education content. It can benefit learners through online learning platforms and personalized learning experiences, which cater to diverse learning needs, including learning at one's own pace through video tutorials and interactive exercises (UNESCO, 2023c). In certain contexts – and if accessible to them – these can better suit girls' needs (**Box 5**). Depending on the context, technology can exacerbate or prevent gender inequality in education, both in terms of access to and the effects of ICT use, which can differ by gender.

With the growing use of technology, gender gaps have emerged in many countries in terms of freedom to access technology. Biased social and cultural norms inhibit equitable access to technology and the Internet at home, in school and in society. Attitudes and perceptions that girls are more vulnerable to online risks can severely restrict girls' access to technology, leading to restrictive practices that limit their engagement with digital technology (Crompton et al., 2021; Naylor and Gorgen, 2020). The COVID-19 pandemic brought some of these divides into sharp relief through the abrupt turn to online learning in many countries.

Gender gaps exist in **education and social outcomes**, ranging from digital skills to exposure to various risks. Girls' and women's progress depends on the context. They have been, and in many countries continue to be, behind in the acquisition of digital skills. But the situation is changing rapidly in some countries, where favourable employment opportunities are opening up. Technology, and the misinformation it generates, can leave girls and women ever more vulnerable to violence and the propagation of gender stereotypes. But it also creates opportunities to communicate empowering messages, to which traditional education channels were not particularly suited.

BOX 4:

ICT can facilitate access to education and improve learning for girls in crisis contexts

In crisis situations, where girls are even more vulnerable, ICT can offer an education lifeline. In Afghanistan, where the Taliban have banned girls' education, Radio Sada-e-Badghis broadcasts recorded sessions of lessons taught by volunteer teachers, helping girls continue their secondary school education. They reportedly reached 70% of girls in the Badghis province (Omar, 2023). Online learning platforms have provided a lifeline for the few girls who can access online resources. The UK-based online learning platform FutureLearn reports enrolling more than 33,000 Afghan students, most of them female, since they offered free access to its premium digital learning platform during the ongoing ban imposed the Taliban regime (Financial Times, 2024).

Several studies have focused on the use of radio for providing access to education for girls (UNESCO, 2021). Educational radio programmes can be effective when applied with certain pedagogical approaches. An evaluation of an intervention in arid and semi-arid zones in Kenya found that radio was effective in improving reading and mathematics when girls listened to radio in groups (Amenya et al., 2021). In Sierra Leone, the Every Adolescent Girl Empowered and Resilient (EAGER) project of the International Rescue Committee supported 32,500 marginalized adolescent girls (FCDO, 2023), combining radio programming with cash transfers and support from a female mentor within the community (Sarr et al., 2020).

One programme offered secondary school girls access to digital resources through low-cost tablets in the Za'atari refugee camp in Jordan. Evaluations suggested it increased girls' confidence and motivation to stay in school (Rowe, 2016), enhanced their desire to learn, improved academic performance (Wagner, 2017), and helped reintegrate out-of-school adolescent girls back into the educational system (UNESCO, 2018).

At the height of the Boko Haram crisis in Adamawa state, Nigeria, the Technology Enhanced Learning for All programme used mobile and radio technology to support 22,000 disadvantaged children, including those who were internally displaced (Premium Times Nigeria, 2016). Within six months of listening to the programme, literacy and numeracy skills improved, in particular among girls (Jacob and Ensign, 2020).

BOX 5:

Some technology-based approaches can support disadvantaged girls' and women's learning in poor and rich countries

Specific education technologies are not expected on their own to be better suited to either sex, as research has shown that learning styles do not differ by gender. Yet features in the design of some technologies might appeal more to either boys or girls. There are also external circumstances where technology may be able to help overcome some of the constraints girls and women face in accessing equitable learning opportunities (Pitchford et al., 2019), which have led to positive effects on their learning (Evans and Yuan, 2021; Jordan and Myers, 2022). A few examples, mostly from Africa, highlight a range of interventions.

Radio. An intervention that targeted out-of-school girls in Balochistan province, Pakistan (Raza, 2022), combining daily 45-minute radio broadcasts with hygiene kits and printed educational materials, led to gains in literacy, numeracy and civic education outcomes (Myers et al., 2023).

SMS. Used alongside other types of technology, interventions that use short messaging services (SMS), also called text messages, can improve learning, even though most studies tend to show no variation in these effects by sex. In Botswana, a project using SMS and phone calls for learners in grades 3 to 5 showed no gender differences in gains in numeracy (Angrist et al., 2022). But in Bangladesh, a study which analysed the effect of a programme combining SMS nudges with conditional cash transfers found that it increased secondary school enrolment for girls and reduced child marriage with relatively low implementation costs (Fujii et al., 2021). In Uganda, a model adopted by the Promoting Education in African Schools project (PEAS, 2021), based on the use of radio lessons combined with paper-based resources and support from teachers via SMS, showed that it benefited girls' learning and that girls were more interested in listening to radio than boys (Damani et al., 2022).

In Kenya, M-shule ('mobile school' in Kiswahili), an SMS platform, was developed with the aim to improve children's and especially girls' learning outcomes by enabling them to catch up when they missed classes. Personalized educational content and quizzes are delivered through SMS on low-tech mobile phones, without the need for an Internet connection. The platform, which reached 23,000 households with grade 1 to 4 students in 20 counties, has been found to improve examination scores by 7% if used for more than an hour per week (Myers et al., 2023).

Learning applications. The iMlango project aimed to improve Kenyan pupils' learning outcomes, enrolment and retention across some 200 primary schools by using technology along with financial incentives to encourage attendance among the most marginalized girls (Ndiku and Mwai, 2016). The use of Maths-Whiz in the project, a virtual math tutor, led to improvement in girls' numeracy (IMlango, 2022).

The use of the learning application (app) Onebillion on tablets in Malawi showed significant gains in numeracy and literacy for grade 1 and 2 learners, with girls benefiting more. When standard pedagogical practices were used, gender differences emerged in grade 1, while interactive practices ensured that boys and girls learned equally well (Pitchford et al., 2019). In the United Republic of Tanzania, an evaluation of RoboTutor software found significant gains in literacy and numeracy but no significant differences by sex (McReynolds et al., 2020).

Online learning. In contexts where access to fast Internet is universal and affordable, online learning can help women with competing work and family responsibilities (Waterhouse et al., 2022). The flexibility of online learning allows learners to choose a time, rhythm and place compatible with their work and family responsibilities. In Australia, a study of adult women found that the choice to study online was largely determined by their family and caring responsibilities (Stone and O'Shea, 2019).

Learning in prison can be a challenging process for women (Cooney, 2018) as they face unique barriers to learn and earn degrees (Incarceration Nations Network, 2020; Weissman, 2022). In the prisons of the US state of Texas, male inmates are more than three times as likely as their female peers to access higher education programmes (Weissman, 2022). Also in the United States, women prisoners in Hawaii (Elias, 2022) and in New England (Smith, 2022) that followed online courses had a positive impact on their learning. A study of 306 female prisoners that took part in an e-learning programme in Portugal found that the course achieved its goals and participants wanted to pursue their studies using this modality (Monteiro et al., 2023).

GIRLS ARE OFTEN ON THE WRONG SIDE OF THE DIGITAL DIVIDE

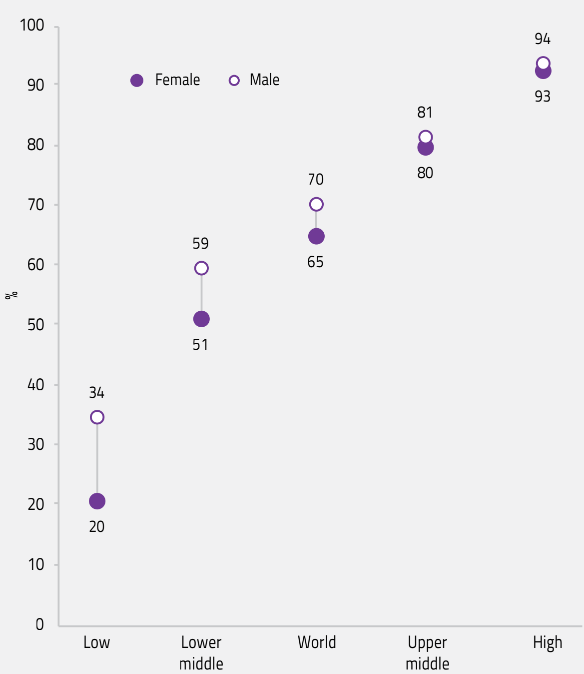
The availability of distance education opportunities depends on the rates of ownership and use of devices, such as mobile phones, tablets and laptops, as well as access to services such as the Internet.

There is a gender gap in **mobile phone ownership**, with 81% of men and 75% of women owning a device in 2023. The gender gap decreases by country income, ranging from 17 percentage points in low-income to 1 percentage point in high-income countries. The divide is more pronounced in smartphone ownership. Women in South Asia are 42% less likely than men to own a smartphone (GSMA, 2023). A 2022 survey showed significant gender gaps in mobile ownership in 3 out of 12 countries, with a difference of 29 percentage points in Pakistan, 20 in Bangladesh and 17 in Ethiopia. In Pakistan, 1 in 5 adolescent women aged 15 to 19, but almost 1 in 2 adolescent men, owned a phone (MacQuarrie et al., 2022).

There is also a gender gap in **Internet use**, with 70% of men and 65% of women using the Internet in 2023 (ITU, 2023a) (**Figure 16**). This 5-percentage-point gap is equivalent to 244 million more men than women using the Internet globally. The gap widens in lower-middle-income (8 percentage points) and low-income countries (14 percentage points). A study of 12 countries reported gender gaps in Internet use exceeding 40% in Bangladesh, Ethiopia and India (GSMA, 2023).

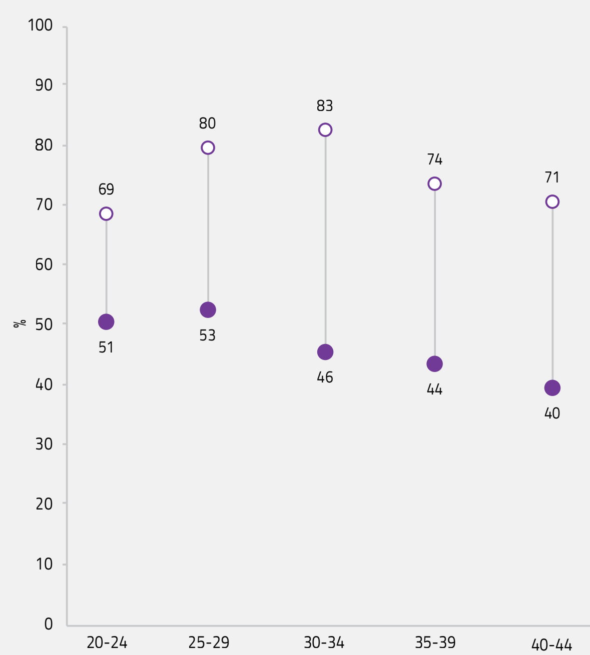
Gender gaps in both mobile phone ownership and access to the Internet are exacerbated when they interact with poverty and location. For example, in Sierra Leone in 2017–18, the gender parity index of mobile phone ownership was 0.81 in urban areas and 0.48 in rural areas; likewise, it was 0.86 among the richest households and 0.34 among the poorest households (Myers et al., 2023) (**Figure 17**).

FIGURE 16:
The poorer a country, the wider the gender gap in Internet use
Internet use, by country income group and sex, 2023



Source: ITU (2023).

FIGURE 17:
The poorer the household, the larger the gender gap in mobile phone ownership in Sierra Leone
Mobile phone ownership by household wealth and sex, Sierra Leone, 2017–18



Source: Myers et al. (2023) based on the 2017–18 Multiple Indicators Cluster Survey.

The intersection of wealth and sex suggests that affordability is a key barrier to women's mobile ownership and Internet use. In Kenya, where 49% of men and 34% of women owned a smartphone in 2021 (GSMA, 2022b), more than half of women surveyed reported affordability as the primary barrier (Myers et al., 2023). In some countries, girls try to circumvent lack of access to devices by owning SIM cards without a mobile phone or borrowing phones from others (Girl Effect, 2023).

The intersection of location and sex suggests that social norms, including perceptions of digital risks and safety, significantly influence girls' engagement with the digital world (Crompton et al., 2021), often leading to more frequent monitoring of girls compared to boys (UNICEF, 2021a). A survey of girls aged 14 to 21 and their parents in Ethiopia, India, Jordan, Kenya, Nigeria, Rwanda and the United Republic of Tanzania showed parents' tendency to believe that girls require more protection than boys from potential online distractions and temptations (Girl Effect, 2023).

Lack of agency exacerbates the gender digital divide (Gattorno et al., 2022). In Ghana, sociocultural norms discourage girls from visiting cybercafes (Steeves and Kwami, 2017). In Gujarat, India, mobile phone bans for unmarried women and girls under 18 were imposed in 2016 to prevent distraction from studies, with fines for usage and rewards for informants (Khan, 2016). In India, boys were more likely than girls to have access to computers outside of school, both at home and in computer centres and cybercafes. While both boys and girls used computers at school, boys were more likely to make use of the Internet (Basavaraja and Sampath Kumar, 2017).

A study on COVID-19 responses in Nigeria revealed that fathers were significantly less likely to allow girls to use the Internet (Malala Fund, 2020). In Ghana, more than 1 in 5 caregivers considered their son's education more important than their daughter's. In families where parents expressed education preferences for boys over girls, girls were spending less time on remote learning (Aurino et al., 2022).

Family approval emerges as a notable barrier to owning a phone. In Pakistan, 22% of women who did not own a phone cited lack of family approval as the primary obstacle, compared to just 4% of men (GSMA, 2023). In Bangladesh and India, girls often face harsh judgements for using mobile phones due to prevailing social norms (Vodafone Foundation, 2018). A survey conducted by the BRAC Institute of Governance and Development of 6,500 rural households in Bangladesh found that 63% identified a male member as being the most able to use digital devices in the household, nearly double the rate for a female member (Joshi et al., 2023). In sub-Saharan Africa, household attitudes to gender, gender roles, cost considerations, security concerns and restrictions on mobility contribute to unequal access to technology for girls at home (Webb et al., 2020).

While technology was a lifeline for learning during the COVID-19 pandemic, competing family responsibilities meant learning continuity was challenging for girls and women. In Ethiopia, only 22% of girls had their time spent on chores reduced to accommodate home study versus 57% of boys (Jones et al., 2021). In Kenya, 74% of adolescent girls but only 46% of boys reported that household chores distracted them from remote learning during COVID-19 school closures (Kenya Presidential Policy and Strategy Unit and Population Council, 2021). Female teachers also had to take on most of the household and child-rearing duties in addition to their teaching duties. Such obstacles limited female teachers' opportunities to experiment and develop their capacity in the use of technology in Ghana (Ananga et al., 2021) and in East Java, Indonesia (Febrianto et al., 2022)

In several contexts, a larger proportion of women than men who own Internet-enabled phones do not use the Internet. Non-usage rates were found to be about twice as high for women than for men in India (12% vs 5%), Kenya (23% vs 10%) and Nigeria (27% vs 15%) (GSMA, 2023). In a study of six Latin American countries, 35% of women and 24% of men reported not knowing how to use a smartphone, while 40% of women and 33% of men reported not knowing how to use the Internet (Agüero et al., 2020).

During the implementation of the One Laptop Per Child program in Ghana, there was a significant gender divide in the use of the devices, particularly in urban settings, as girls were often expected to assist with household chores (Steeves and Kwami, 2017). Such barriers to girls' access to technology mean that interventions focused on hardware tend to have low impact for girls (Nicolai et al., 2023; Steeves and Kwami, 2017). Similar evidence of low impact from other studies (Evans and Yuan, 2021; Jordan and Myers, 2022) is a reminder of how hardware was inadequately integrated into pedagogical processes and its deployment was ultimately unsustainable (Ames, 2019; Souter, 2021).

African governments have integrated gender dimensions into their ICT national plans. Botswana's national broadband strategy sets gender-specific targets for smartphone access, digital literacy and ICT graduates, and proposes a strategic plan by the Universal Service and Access Fund to bridge gender disparities. Nigeria's National Broadband Plan (2020–2025) seeks to enable 5 million more women to use the Internet by 2023. Rwanda's 2024 ICT Hub Strategy includes a gender section. The government is committed to accelerate telephone use in rural areas through Connect Rwanda, which places special emphasis on female farmers. In Senegal, the Digital Senegal 2016–2025 plan has committed to incorporating gender considerations in all broadband policy decisions.

GENDER GAPS IN DIGITAL SKILLS ARE RAPIDLY CHANGING

SDG global indicator 4.4.1 is a self-reported measure of the use of ICT. In 2015, nine tasks were specified to be part of the global indicator. As these were meant to be carried out on a computer or a tablet, there have since been demands to amend the list of tasks assessed, for instance, to also capture activities that can be performed with smartphones or to drop activities that are becoming obsolete. The International Telecommunication Union (ITU) has added measures on safety, such as the use of passwords, privacy settings and verifying the reliability of information found online. Overall, the data paint a picture of considerable gender disparity in ICT skills, albeit one that has several nuances.

Data from 90 countries in 2014–21 overrepresent upper-middle- and high-income countries (as there are data for almost 50% of them) but still provide a global picture (as data for almost 30% of low- and lower-middle-income countries are available). Two of the nine ICT skills are used to demonstrate gender disparity among youth and adults: being able to use a basic arithmetic formula in a spreadsheet and being able to write a computer program using specialized programming language. The data are presented for two age groups: 15- to 24-year-old youth and 25- to-74-year-old adults. Data come from the ITU database and, in the case of youth, from Multiple Indicator Cluster Surveys.

Depending on their complexity, ICT skills require a minimum level of literacy and numeracy skills, while their distribution in the population is also determined by the availability of infrastructure, devices and relevant labour market opportunities, as well as the gender stratification of these jobs.

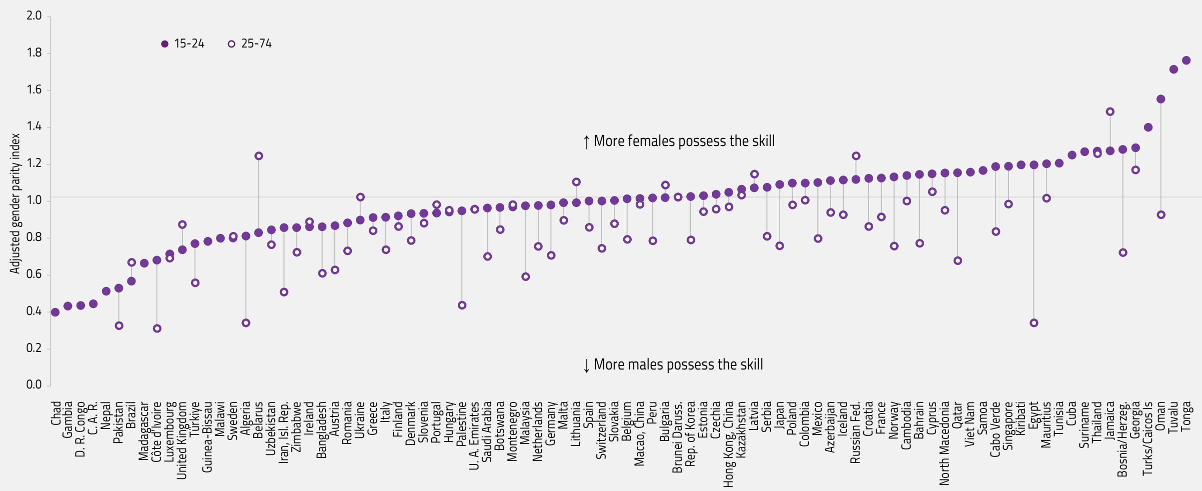
With respect to spreadsheet skills, the prevalence in the youth population is about 1% in low-, 14% in lower-middle-, 33% in upper-middle- and 57% in high-income countries. The average gender parity index increases from 0.82 among adults to 0.91 among youth. The percentage of countries that have disparity at the expense of females falls from 79% among adults to 44% among youth, while the percentage of countries that have disparity at the expense of males increases from 11% among adults to 40% among youth.

Countries with large disparity at the expense of young women tend to be low-income sub-Saharan African countries and South Asian countries (e.g. Nepal and Pakistan). Countries with large disparity at the expense of young men tend to be Caribbean and Pacific Small Island Developing States, Arab countries (e.g. Oman and Tunisia) and South-eastern Asian countries (e.g. Thailand and Viet Nam). For example, for every 100 young men with spreadsheet skills, there are only 40 young women in Chad, 43 in Gambia and 44 in the Democratic Republic of the Congo with such skills. In contrast, for every 100 young men with spreadsheet skills, there are 117 young women in Egypt, 136 in the Turks and Caicos Islands and 167 in Tuvalu with such skills (**Figure 18**).

FIGURE 18:

There is near gender parity in spreadsheet skills among youth

Adjusted gender parity index of the ability to use a basic arithmetic formula in a spreadsheet, by age group, 2014–21



Source: ITU database and MICS Survey Findings reports.

With respect to programming skills, the prevalence in the youth population is about 0.5% in low-, 2% in lower-middle-, 6% in upper-middle- and 14% in high-income countries. The African Girls Can Code Initiative aims to raise the level of coding skills while also bridging the gender divide (**Box 6**). The average gender parity index increases from 0.50 among adults to 0.75 among youth. The percentage of countries that have disparity at the expense of females falls from 93% among adults to 72% among youth, while the percentage of countries that have disparity at the expense of males increases from 4% among adults to 21% among youth.

Countries with large disparity at the expense of young women tend to be high-income European countries. For instance, for every 100 young men with programming skills, there are only 21 young women in Ireland, 24 in Hungary and 28 in Austria with such skills. In contrast, for every 100 young men with programming skills, there are 105 young women in Malaysia, 110 in Saudi Arabia, 118 in Albania and 130 in the State of Palestine with such skills (**Figure 19**).

BOX 6:

The African Girls Can Code initiative aims to bridge a critical gender gap

The African Girls Can Code Initiative, commissioned by UN Women and the African Union Commission in collaboration with the ITU, aims to bridge the gender divide on a critical digital skill in Africa (UN Women, 2024). The initiative was launched in 2018 with support from the Danish Embassy in Ethiopia. It targets 2,000 young women aged 17 to 25, aiming to empower them to become computer programmers, creators and designers, and preparing them for careers in the ICT sector.

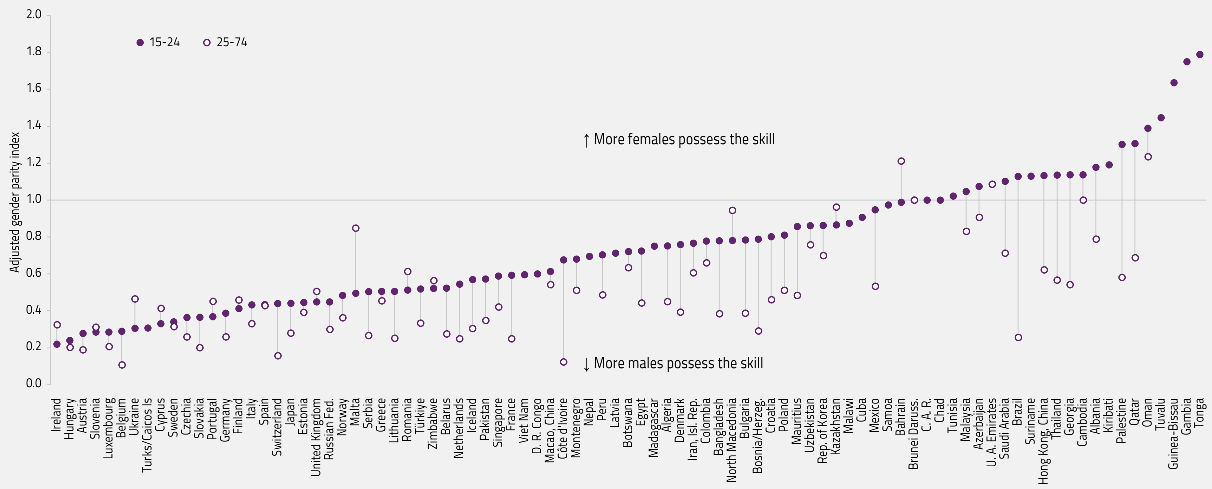
The initiative operates through two main strategies: coding camps and mainstreaming ICT, coding and gender into national curricula. Camps not only provide direct training to girls but also foster an environment of mentorship and networking with field professionals. By 2022, the initiative had trained 600 participants from 35 countries, had developed a guide for integrating computing and gender into secondary education curricula and had launched an eLearning platform (UN Women, 2022). In April 2022, the initiative entered its second phase, launching two-week coding camps in 11 countries. The first coding camp was held in Rwanda, where participants strengthened their knowledge in coding, robotics and key gender equality concepts.

There is no clear association between the level of an ICT skill in the population and the level of gender disparity, although there are higher levels of gender disparity at the expense of women at very low overall levels of spreadsheet skills (**Figure 20**).

FIGURE 19:

Gender disparity in programming skills is large, especially in rich countries

Adjusted gender parity index of the ability to write a computer program using specialized programming language, by age group, 2014–21

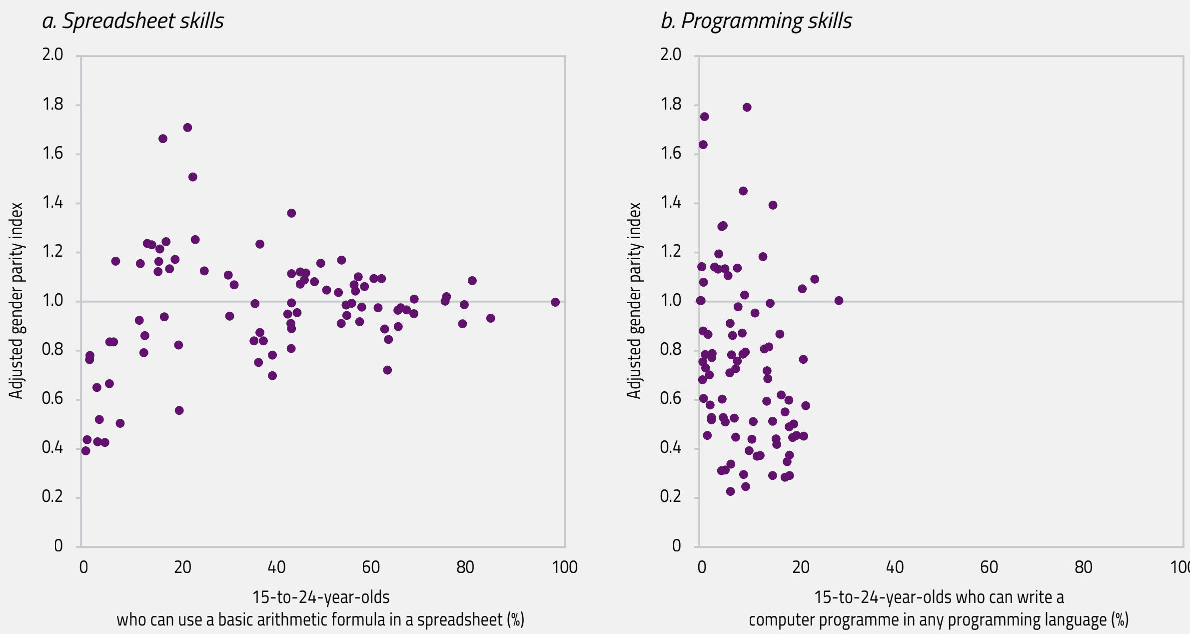


Source: ITU database and MICS Survey Findings reports.

FIGURE 20:

There is no clear link between gender disparity and average youth skill levels

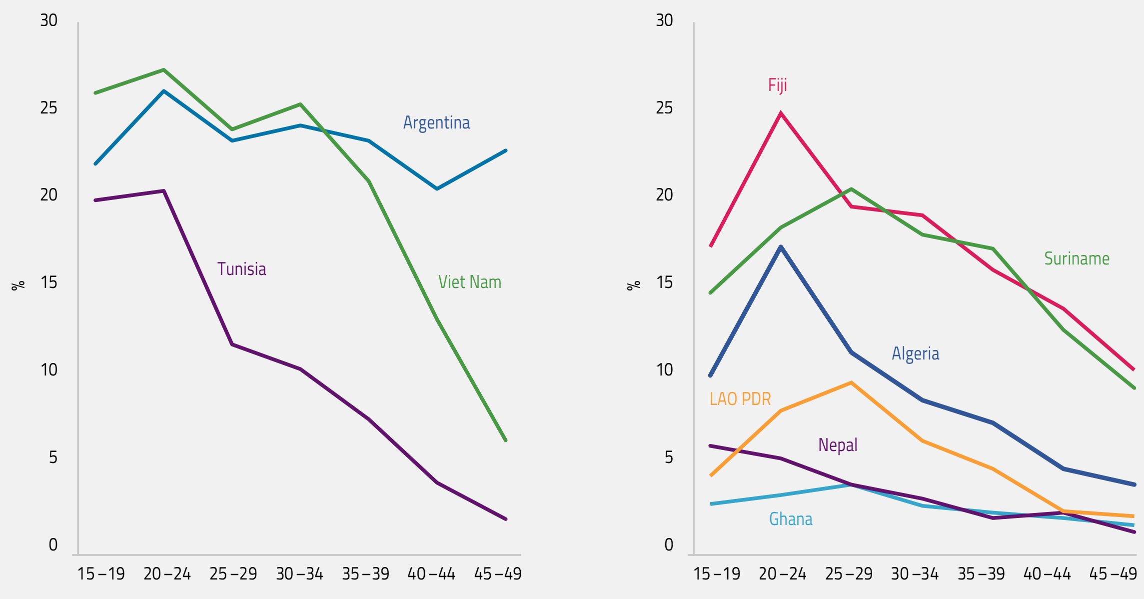
Average level of ICT skills in the youth population and adjusted gender parity index, 2014–21



Source: ITU database and MICS Survey Findings reports.

The speed with which skills are getting diffused in the female population is further revealed by Multiple Indicator Cluster Surveys. In a sample of 36 low- and middle-income countries, 20- to 24-year-old women are twice as likely to be able to use a basic arithmetic formula in a spreadsheet than their 40- to 44-year-old peers. But there are considerable differences in the pace of change between countries. In Argentina, there is practically no difference between these two cohorts, while in Tunisia, the younger cohort is almost four times as likely as the older cohort to have this skill. There are also differences in the peak age of skill prevalence, which is observed among 25- to 29-year-olds in Suriname, 20- to 24-year-olds in Algeria and 15- to 19-year-olds in Nepal (**Figure 22**).

FIGURE 21:
Younger women acquire ICT skills in far greater numbers
Women who reported using a basic arithmetic formula in a spreadsheet, selected middle-income countries, by age group, 2017–21



Source: MICS Survey Findings reports.

TECHNOLOGY CAN AFFECT GENDER NORMS POSITIVELY AND NEGATIVELY

ICT permeates and influences social and economic life, including, obviously, education. In the case of influencing gender norms, its strengths are also its weaknesses. ICT can be used to increase communication on positive topics. Well-designed messages transmitted through radio, television and digital channels can bypass traditional obstacles for communicating with hard-to-reach groups on issues such as sexual and reproductive health rights. In contrast, ICT can facilitate the dissemination of negative and false information, through the ease with which large volumes of low-quality content circulates on the Internet and social media.

TECHNOLOGY FACILITATES ACCESS TO COMPREHENSIVE SEXUALITY EDUCATION

Accessing the Internet is commonly associated with risks to children from exposure to pornography, which may lead to ‘poor mental health, sexism and objectification, sexual violence, and other negative outcomes’ (UNICEF, 2021b). Yet, technology at the same time can have a positive influence on gender norms through providing access to sexuality education opportunities outside of school. Sexuality education can be directed at the entire population through low-tech channels (**Box 7**), or it can be targeted, providing interactive and personalized learning experiences in a safe and confidential learning environment. The technology used is low cost, private and effective in tailoring messages for specific populations (Brayboy et al., 2018).

Technology-enhanced strategies are effective for traditionally excluded groups and offer greater content and style flexibility (Fiellin et al., 2017; Teadt et al., 2020).

Digital technology can promote shifts in gender norms that move towards social justice, primarily by providing spaces where dominant gender norms can be challenged (Rentschler and Thrift, 2015; Washington and Marcus, 2022). Digital strategies in sexual and reproductive health are evolving, with social media–based and interactive technology becoming more common than the mobile phones and text messaging used more often before 2015 (Huang et al., 2022). Digital redesign of traditional games, such as Help Pinky, has been used to engage girls in rural India in discussions about menstrual health, addressing information gaps and challenging taboos (Jain and Yammiyavar, 2015). In Lesotho, the Nokaneng app helps students access information on gender-based violence and on legislation protecting women and girls from violence (AUDA-NEPAD, 2023). The CSE Learning Platform, primarily targeting youth in sub-Saharan Africa, aims to encourage knowledge sharing and learning across countries, featuring a digital library and an 'Ask and Share' forum (UNESCO, 2023d).

Smartphone- and iPad-based applications can also improve reproductive health knowledge. The Girl Talk app increased sexual health knowledge in girls aged 12 to 18 (Mesheriakova and Tebb, 2017). Similar effects were reported for the application by the Girls' Talk+ programme, directed at adolescent girls with disability in the Netherlands (van den Toren et al., 2022). A survey among 936 young adults in Kenya, Nigeria and South Africa found that 84% consider social media appropriate for sexual health communication (Olamijuwon and Odimegwu, 2022).

In Uruguay, the JAAKLAC initiative developed a Guide on Comprehensive Digital Sexual Education for Adolescents, as part of an Adolescent Digital Resilience project, which was disseminated through social media campaigns (JAAKLAC, 2022; Magnone, 2021). In Guayas province, Ecuador, 70% of secondary school students agreed that social networks facilitate collaborative content creation for comprehensive sexuality education (Zhapa-Bravo and Ochoa-Encalada, 2021).

In the United States, the web-based Health Education and Relationship Training programme aims to enhance adolescent girls' sexual assertiveness skills and decision-making. Its evaluation has shown better sexual assertiveness skills, better intentions to communicate about sexual health, better knowledge regarding HIV and other sexually transmitted infections, safer sex norms and attitudes, and condom self-efficacy among those exposed to the programme compared with those in the control group (Widman et al., 2018).

Teachers can also access comprehensive sexuality education through technology. In Thailand, the Ministry of Education, in collaboration with the Path2Health Foundation, has developed e-learning courses to strengthen teachers' skills in providing sexuality education and life skills training.

BOX 7:

Radio and television can educate men and women about gender equality and sexuality

Radio and television have the potential to positively impact learning across all age groups, also contributing to shifting attitudes and gender norms, enhancing knowledge and understanding on a broad range of issues including sexual and reproductive health rights.

In Nepal, two radio dramas, Mai Sari Sunakhari (Orchid, like me) broadcast in Nepali in 2016–18 and Hilkor (Ripples in the water) broadcast in Maithili in 2016–17, addressed critical topics such as child marriage, domestic violence, education, family planning, gender equality, gender-based violence, maternal and child health, nutrition and reproductive health. Among listeners, 11% reported being motivated to seek family planning and reproductive health services, with men (17%) showing notably higher motivation than women (10%). Listeners were also more likely to disapprove of child marriage and to take action against it (Nasruddin, 2021).

Two national radio programmes were produced by the BBC for the EAGER programme in Sierra Leone, with accompanying social media content (**Box 4**). Designed to engage caregivers and community influencers with trusted gender-sensitive messages, they aimed to address discriminatory gender norms. Among the population aged 15 and over, 3 in 10 had listened to at least one episode, while 2 in 10 were reached regularly. Men were more regular listeners than women, reflecting higher levels of radio access. Regular listeners showed a better understanding of the risks of early marriage and more positive attitudes toward girls' rights to decide if, and whom, they want to marry, as well as towards sexual and reproductive health and rights (BBC Media Action, 2023).

BOX 7 CONTINUED:

UNESCO, the United Nations Population Fund, SAfAIDS and Save the Children launched a Let's Talk radio drama series on early and unintended pregnancy in 2022 in Eastern and Southern Africa (UNESCO, 2022c). It provided information on sexual and reproductive health and rights, modern contraceptive use, early onset of sexual activity, violence against women and improving young people's access to services. While targeting adolescent girls and young women, the drama also engaged men and boys as agents of change. In Malawi, the first country to air the drama in 2022, it reached 10 million people, initially interacting more with men but gradually seeing an increase in women voicing their concerns (Global Partnership Forum on CSE, 2023).

Television can serve as a powerful vehicle for changing mindsets and behaviours. In Latin America, telenovelas are an entertainment staple and have influenced sexual health (Burns, 2021). In Mexico, Vencer el Miedo (Overcoming fear), a telenovela co-produced by the Population Council and Televisa, tackled issues such as teenage pregnancy and gender-based violence, reaching 3.5 million viewers every day, primarily aged 13 to 17 (Population Media Center, 2020, 2022). Adult viewers were 1.6 times more likely than non-viewers to discuss condoms and other contraceptive methods with their adolescent children during the show's run. Young adult viewers were 1.8 times more likely to have used dual contraception to prevent unintended pregnancies and sexually transmitted infections. A parallel social awareness media campaign, Gánale a las Ganas (Beat the desire), which encouraged positive behaviours around sexual and reproductive health, reached 41.8 million people. Its success led to its distribution in the Dominican Republic, El Salvador, Honduras, Nicaragua and the United States (Population Media Center, 2022). In Honduras, Vencer el Pasado (Overcoming the past), a partnership between USAID and Televicentro, followed four women of different ages addressing gender-based violence, sexual assault, sexual harassment, cyberbullying, cyberstalking and stigma and discrimination based on sexual orientation and gender identity (USAID, 2023).

A quasi-experimental evaluation of 3,000 households in Kabul, Afghanistan, demonstrated that families who frequently viewed Baghch-e-Simsim, a children's TV show focusing on academic skills and gender equity modelled on the popular US-based Sesame Street programme, held more gender-equitable beliefs (Foulds et al., 2023). In Senegal, a community-based educational entertainment television series, C'est la Vie!, broadcast in film clubs in rural areas aims to enhance knowledge, attitudes and practices on gender-based violence, sexual and reproductive health, and maternal and child health. Despite implementation issues, the programme effectively communicated on these sensitive topics (Le Port et al., 2022) .

SOCIAL MEDIA NEGATIVELY AFFECTS WELL-BEING AND REINFORCES GENDER NORMS

Digital technology and the Internet offer excellent potential for teaching and learning but also come with risks related to personal data misuse, privacy invasion, abuse, identity theft, offensive messages and images, cyberbullying, scams, fake news, and misinformation (Smahel et al., 2020). Social media platforms shape and are shaped by existing social inequalities (Washington and Marcus, 2022), with some algorithms magnifying negative gender norms and practices in schools, with an impact on children's well-being.

According to the 2021/22 Health Behaviour in School-aged Children study of the World Health Organization in Europe, girls' well-being and mental health are under more strain than boys. The share of adolescent girls (28%) who reported frequently feeling lonely is nearly twice that of boys (13%) (Cosma et al., 2023). Algorithm-driven image-based content can expose girls to inappropriate material, ranging from sexual content to videos that glorify unhealthy behaviours or unrealistic body standards (Lin, 2023). Such exposure can have detrimental effects on girls' self-esteem and body image. Girls often spend more time on social media than boys. In the United Kingdom, a study reported that 10% of 10-year-old girls reported spending one to three hours a day (compared with 7% of boys), increasing to 43% at age 15 (31% among boys). Girls that interacted on social media for an hour or more on a school day had lower levels of well-being than those who interacted less. Among boys, there were no cross-associations between well-being and their social media usage (Booker et al., 2018).

According to the 2019 Global Burden of Disease study, girls (0.28%) are twice as likely as boys (0.15%) to suffer an eating disorder in their lives. A review of young people aged 10 to 24 years in 17 countries has highlighted the association between the use of social media and body image concerns, eating disorders and poor mental health (Dane and Bhatia, 2023). Facebook-using pre-teenage girls (Tiggemann and Slater, 2013), female secondary school students (Meier and Gray, 2014; Tiggemann and Slater, 2013) and female university students (Fardouly et al., 2015) reported more body-related image concerns than non-users. Facebook's own research found that 32% of teenage girls said that when they felt bad about their bodies, Instagram made them feel worse (Wells et al., 2021). Browsing photo posts on Instagram has also been negatively associated with body esteem among adolescent girls in Singapore (Chang et al., 2019). Taking selfies on social media, rather than simply browsing, was associated with body-related and eating concerns among young women aged 18 to 29 (Cohen et al., 2018).

The addictive design of TikTok, characterized by short, engaging videos, can lead to excessive screen time, distracting students from academic responsibilities and extracurricular activities (**Box 8**). The platform's instant gratification model may also affect attention spans and learning habits, making sustained concentration on educational tasks more challenging. For girls, who often face societal pressures to excel academically while also navigating social dynamics online, this can add an additional layer of stress and distraction, making it particularly inappropriate (Amnesty International, 2023; Center for Countering Digital Hate, 2022).

BOX 8:

TikTok has reshaped how young people, especially girls, engage with digital content

In 2023, TikTok counted approximately 1.9 billion users globally. More than one in three of its users are aged 18 to 24. While there are more men users in total, the share of girls is higher among those aged 18 to 24 (What's the Big Data, 2024). Since the pandemic, the platform has been used for educational purposes. For example in the United States, one in four TikTok users used it for educational purposes in 2022 (Kaur, 2023). In the United Kingdom, 40% of young people use it to search for content (McKeown, 2023).

TikTok's widespread adoption in schools and among students has, however, raised significant concerns regarding safety, privacy and mental health. TikTok collects vast amounts of user data, including personal information, location and browsing habits. There is a risk of personal information being misused, leading to privacy invasions or predatory behaviour. The platform's interactive nature, allowing comments and direct messages, can become a conduit for harassment and bullying. Girls may be more susceptible to gender-based cyberbullying, including body shaming, sexual harassment and stalking, which can lead to anxiety, depression and other psychological stresses (Center for Countering Digital Hate, 2022).

TikTok's algorithm targets teenagers with body image and mental health content every 39 seconds, with content related to suicide every 2 minutes and 36 seconds, and with content related to eating disorders every 8 minutes, potentially exacerbating mental health issues among impressionable viewers (Center for Countering Digital Hate, 2022a, 2022b). One in two videos displayed after spending 5 to 6 hours on the platform are 'mental health–related and potentially harmful' (Amnesty International, 2023). Many universities in the United States have explicitly banned TikTok from their campuses. Montana was the first state to introduce a complete ban on all personal devices and bar app stores from offering TikTok for downloading (Michels, 2023).

Well-being is important for learning. There is consistent evidence of the causal relationship between higher levels of emotional, behavioural, social and school well-being and academic achievement. Emotions guide judgement and action in transferring skills and knowledge from the structured school environment to real-world decision making (Immordino-Yang and Damasio, 2007). Early educational psychologists believed learning was inherently emotional. This has now been scientifically established through advances in neuroscience (Immordino-Yang et al., 2019). Cognitive skills that are important for learning, such as attention and memory, are strongly linked to or guided by emotions (LeBlanc and Posner, 2022). At the same time, promoting an inclusive school climate that fosters a feeling of belonging for all school community members contributes to successful learning outcomes. Students who feel safer are more engaged (Côté-Lussier and Fitzpatrick, 2016). A longitudinal study of families in western England found that children with better emotional well-being made more progress in primary school and are more engaged in secondary school (Gutman and Vorhaus, 2012).

But it is being shown that technology and the use of social media can negatively affect well-being. Recent studies tend to report negative impacts of screen time in various domains, including sleep and eating disorders (Law et al., 2023; Trott et al., 2022), lower well-being, less curiosity, self-control, and emotional stability, and higher anxiety or depression (Twenge and Campbell, 2018).

TECHNOLOGY CAN PROMOTE SCHOOL-RELATED GENDER-BASED VIOLENCE

School-related gender-based violence is a global concern. Within this context, digital technology is believed to be contributing to rising levels of sexual violence in the form of online sexual solicitation, coercive sexting and cyberdating violence (Stoilova et al., 2021). More than four in five undergraduate students in Canada reported experiencing at least one type of sexual violence facilitated by technology, the most common being unwanted sexually explicit comments, emails or text messages (Snaychuk and O'Neill, 2020).

Image-based sexual abuse involves non-consensual sharing of intimate images, disproportionately affects girls, but also gay, lesbian, bisexual, transgender and queer youth (LGBTQ) (**Box 9**), undermining their safety, dignity and right to education. Cyberflashing is one form of sexual harassment, which implies receiving explicit pictures, uninvited, to a device such as a phone or tablet via Wi-Fi or Bluetooth. It can be used in schools to bully, intimidate and humiliate students. A third of undergraduate female students in Canada had received inappropriate and/or unsolicited photographs of male genitalia (Salerno-Ferraro et al., 2022). In a survey of girls in schools and colleges in the United Kingdom, 88% said that they had been sent pictures or videos they did not want to see (Ofsted, 2021).

While most evidence is not from education settings, the prevalence of this form of abuse among school-aged children makes it likely that it is taking place in school environments. In Belgium, among young people aged 15 to 25, more than half of the girls had been cyberflashed compared to a quarter of boys. Larger shares are observed among older teenagers (Van de Maele et al., 2023). In Viet Nam, more girls than boys received threating or sexual content by messages or pictures and experienced more cyberbullying and exposure to stigma (UNICEF, 2021a).

Artificial intelligence opens unchartered territory of harassment through deep fakes, especially images. Between 2020 and 2022, there was a 360% increase in 'self-generated' sexual imagery of children aged 7 to 10 (WeProtect Global Alliance, 2021). This problem is preventing school environments from being safe. In Rio de Janeiro, Brazil, deep-fake pornographic images of some 20 girls were circulated to their classmates (Winnard, 2024) and a similar story emerged of images circulating in a school in Spain (El Pais, 2023). Teachers, and particularly female teachers, are also potential victims. A teacher in Texas was targeted by a student who digitally created fake revealing photos of her and shared them online (Hurtado, 2023).

These abuses are only one type of cyberbullying, a form of bullying behaviour fuelled by access to smartphones and other devices (UNESCO, 2023a). Girls are more likely to be targeted. On average, across Organisation for Economic Co-operation and Development (OECD) countries with available data, 12% of 15-year-old girls reported having been cyberbullied, compared to 8% of boys (OECD, 2019). A study of undergraduate students at a public university in Saudi Arabia showed that nearly half of all participants admitted to being harassed, stalked or bullied on different digital platforms, with female students more likely to be recipients of unwanted sexual messages and photos (Alismaiel, 2023).

Boys are more likely to be perpetrators than victims. Cyberbullying affected 15% of grade 8 and 12 students in Bengaluru, India. While boys and girls were equally victimized, boys were more likely to be both victims and offenders (Ranjith et al., 2023). In Türkiye, a study of students aged 14 to 17 found that boys were 1.8 times more likely than girls to engage in cyberbullying behaviour (Şahin and Ayaz-Alkaya, 2023). In Beijing, China, among students aged 13 to 16, boys reported higher rates of engaging in cyberbullying compared to girls (Wang et al., 2023).

Girls are more likely to be victimized through social media, while boys are more likely to experience cyberbullying through video games and mobile phone texts (Stoilova et al., 2021). Cyberbullying increases as people spend longer hours on social media (Ortega-Ruipérez et al., 2021). Globally, women aged 16 to 24 spend on average 2 hours and 59 minutes per day on social media compared to 2 hours and 32 minutes among boys (Kemp, 2024). A longitudinal study tracking some 10,000 teenagers in the United Kingdom from 2013 to 2019 found that, initially, 43% of the 13- to 14-year-olds regularly checked social media multiple times per day. The share rose to 59% the following year and to 69% three years later. Social media seemed to have a stronger impact on girls' well-being than boys', while cyberbullying was found to cause more harm to girls' well-being than lack of sleep or exercise (Department for Education, 2016; Viner et al., 2019).

BOX 9:

Non-binary students are more at risk of online bullying

LGBTQ children are at a higher risk of victimization (Stoilova et al., 2021). Responses to a global poll of 7- to 18-year-olds showed that the share of those of unspecified gender (50%) was higher than among girls (37%) and boys (29%) who considered it very likely to encounter online harm (WeProtect Global Alliance and Office of the Special Representative of the Secretary General on Violence Against Children, 2023).

A survey among young women aged 15 to 25 in 22 countries suggested that 42% of those who identified as LGBTQ had experienced online harassment because of their sexuality (Plan International, 2023). In 2019, 52% of 12- to 17-year-old secondary school LGBTQ students in the United States reported having been cyberbullied, compared to 35% of other students (Hinduja and Patchin, 2020). In Indonesia, Malaysia, the Philippines and Thailand, girls and LGBTQ communities faced gender-based risks and threats online such as being body-shamed and receiving unwanted sexual advances (UNICEF, 2021a).

In Canada, non-binary youth aged 12 to 17 experienced cybervictimization at twice the rate of girl and boy peers (Government of Canada, 2023). The Youth Risk Behaviour Survey in the United States shows record levels of violence and persistent feelings of sadness and loneliness among secondary school teenagers who identify as LGBTQ (Centers for Disease Control and Prevention, 2023).

COUNTRIES ARE BEGINNING TO TAKE ACTIONS TO TACKLE DIGITAL RISKS

Faced with the growing threat of gender-based violence, cyberbullying and disinformation, countries are beginning to take action. Portugal has implemented comprehensive guidelines on teaching about gender, citizenship and Internet security across all education levels (GREVIO, 2019). Slovenia has run projects to raise awareness about online dating violence among youth for the successful prevention of and protection from online violence and harassment of girls and women (GREVIO, 2021).

The need to protect children and youth against online digital risks is gaining momentum worldwide. International conventions, such as the 2011 Istanbul Convention, provide foundational legal instruments for combating cyberbullying and online violence, emphasizing the need for comprehensive policies to protect women and girls online and criminalizing offensive actions and behaviour.

Globally, an explicit definition of cyberbullying remains limited in legal frameworks, with less than half of countries (47%) implementing laws or policies focused on cyberbullying prevention in educational contexts (Right to Education Initiative, 2023). A similar share of countries has established standards for students or teachers to prevent and address cyberbullying and online abuse (UNESCO, 2023c). In Italy, a 2017 law stipulated preventive actions and a strategy of attention, protection and education for children considering both their situation as victims and perpetrators (Italy Ministry of Health, 2023). In the United States, the Kids Online Safety Act, proposed in February 2022 and amended in May 2023, requires social media providers to provide an environment that is safe by default, with options to protect children's information, disable addictive product features and opt out of personalized algorithmic recommendations. It creates a duty for online platforms to prevent and mitigate specific dangers to minors, including the promotion of suicide, eating disorders, substance abuse and sexual exploitation (Singer, 2024).

Experts call for public interventions for and limits to screen time for children (Nagata et al., 2022). At the international level, guidelines or recommended screen time limits exist, most often under the purview of health authorities, but it is up to parents to follow them (UNESCO, 2023c). The World Health Organization recommends less than an hour of sedentary screen time for children aged between 1 and 5 years (WHO, 2019). There are commonly debates on the age at which children should be allowed to have mobile phones, as for instance in Spain (Zafra, 2023).

Concerns over data privacy, safety and well-being also underpin debates about the use of technology in schools, especially by students at young ages. The use of smartphones in schools is contentious. Studies, primarily from high-income countries, show that banning mobile phones from schools improves academic performance, especially for low-performing students. About 1 in 4 countries have enshrined such bans in laws or policies (UNESCO, 2023c). Some countries ban phones for younger students (e.g. Finland and France) and others for their older peers (e.g. the Netherlands).

There is no guarantee, however, that banning phones will reduce bullying and child abuse. A 2019 meta-analysis in Australia found that 99% of students who were cyberbullied were also bullied face-to-face (Jadambaa et al., 2019). A study of secondary school students in Bermuda found that there was no relationship between Internet time and online victimization, suggesting that strong relationships with parents and positive experiences at school were more protective against cyberbullying than restricting phone use (Davis and Koepke, 2016).

Some countries are tackling the issue through curricula and teacher training. In Cambodia, the Ministry of Education, Youth and Sports has developed a resource for primary and secondary schools on child abuse, including online sexual violence against children. Viet Nam has made classes on the prevention of sexual abuse mandatory in primary schools and developed manuals for staff (ECPAT, 2022). In Spain, Gaptain, a non-government organization, developed the Kids Centric Universe, an educational platform to promote cybersecurity in educational environments. It uses video games to evaluate students and artificial intelligence to assess cybersecurity risks. It has trained more than one million students in Spain.

Skills to recognize misinformation are also important, particularly to identify fake content produced by artificial intelligence (UNESCO, 2023b). In her report to the 47th UN General Assembly, the United Nations Special Rapporteur for freedom of opinion and expression called on states to integrate gender perspectives into their policies and programmes to address disinformation and misinformation, including in media, information and digital literacy programmes (OHCHR, 2021).

Little girl looking through a microscope in science class. Curious toddler discovering an interest in science.

Credit: © Nicoleta Ionescu / Shutterstock.com

Education can determine whether technological development is gender equal

When talking about technology in the context of education, many people will think of the impact of digital technology on education. Yet the reverse is as important, if not more so: education influences technological development. For that reason, education needs to be equitable and inclusive in order to develop the best talents of both girls and boys. However, in practice there are imbalances for girls early on. Mathematics anxiety and lack of self-efficacy feed into later subject choice and careers. Leaving girls out of equal opportunities to study and work in science, technology, engineering and mathematics (STEM) careers means that technology development risks being male-oriented with consequences, not least a possible gender bias and stereotypes in algorithms and product development. Without significant changes, the increasing use of digital technologies in education risks further entrenching these disparities rather than alleviating them (Unwin et al., 2020).

GIRLS' CONFIDENCE IN STEM SUBJECTS IS HARMED EARLY

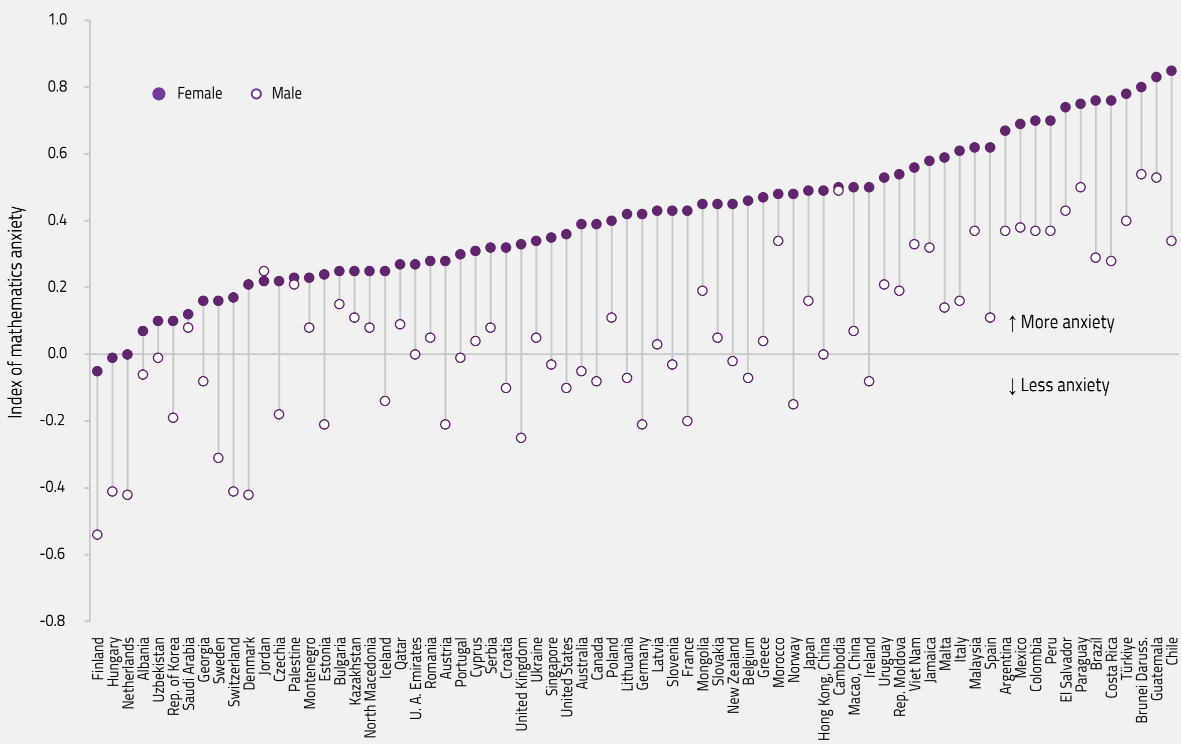
Mathematical capability and knowledge are critical to developing STEM skills and working in STEM fields (Xie and Liu, 2023). However, girls' confidence in these subjects tends to be lower than boys', even when they perform well (Liu, 2018). It has been estimated that one in five people feel anxious about mathematics but anxiety levels are higher among girls (Eden et al., 2013). In all participating education systems in the 2019 TIMSS, except Bahrain and Egypt, boys reported being significantly more confident in mathematics than girls (Hencke et al., 2022).

As part of the 2022 PISA survey, an index of mathematics anxiety was developed based on student responses to questions about their emotions regarding mathematics. Three Arab countries (Jordan, the State of Palestine and Saudi Arabia) and Cambodia were the only ones without a gender gap. The largest absolute gender gaps in the anxiety index value were reported in Denmark, France, Germany and Norway (**Figure 22**). In France, the French longitudinal survey of Children, Elfe, which is following 18,000 children born in 2011 for 20 years, found that girls are as good at calculations as boys up to grade 1, but gaps emerge between ages 5 and 6 and worsen thereafter (Fischer and Thierry, 2022). There is a negative correlation between girls' mathematics anxiety and their mathematics score. At least a quarter of the total variation in mathematics performance across countries could be explained by the differences in overall mathematics anxiety in each country (OECD, 2023). Conversely, a study based on PISA data from an earlier round found a positive relationship between intending to pursue mathematics and mathematics performance, which was stronger among boys than among girls (Breda et al., 2023).

FIGURE 22:

Girls are far more anxious about mathematics than boys

Index of mathematics anxiety, 15-year-old students, selected countries, 2022



Notes: The index of mathematics anxiety was constructed using the six student responses to a question asking students how much they agree ("strongly agreed", "agreed", "disagreed" or "strongly disagreed") with six statements about their feelings when studying mathematics (e.g. "I often worry that it will be difficult for me in mathematics classes", "I get very tense when I have to do mathematics homework"). Positive values in this index mean that students reported greater anxiety towards mathematics than the average student across OECD countries.

Source: GEM Report team analysis of 2022 PISA data.

Boys' and girls' educational trajectories diverge at around the age when they start deciding about their careers. The design of education tracks tends to favour boys over girls. In Canada (Card and Payne, 2021) and Ireland (Delaney and Devereux, 2019), different subject choices among boys and girls in secondary school explain most of the subsequent gender gap. In Italy, half of the gender gap in tertiary STEM graduation is attributed to gender differences in the mathematics and science content of the respective secondary school curricula (Granato, 2023).

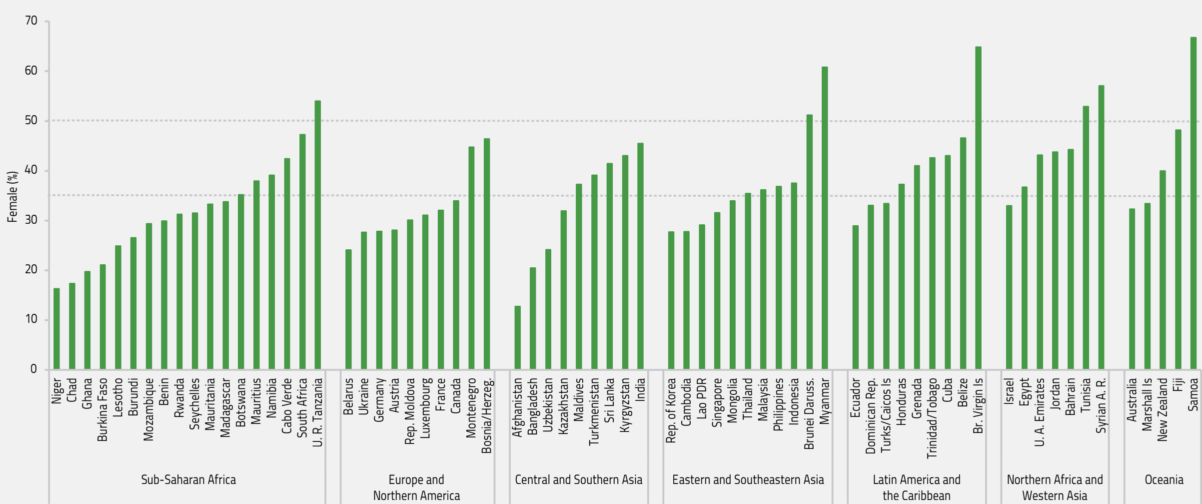
Globally, women are considerably less likely to choose STEM fields. In 2018–23, the share of STEM graduates who were female was 35% (**Figure 23**). In 12 out of 122 countries, at most one in four graduates were female. Of those, five were in sub-Saharan Africa, but there were also high-income countries, such as Chile and Switzerland. In European and other high-income countries, the share of women in STEM fields of study drops heavily at the end of secondary school. In OECD countries, women make up only 31% of those entering STEM programmes, compared with over 75% in education, health and welfare (OECD, 2024). The proportion of female STEM graduates exceeds 40% in Greece, Iceland and Poland. At the opposite end, there were nine countries where the majority of STEM graduates were female, notably Arab States, such as the Syrian Arab Republic and Tunisia. High shares of female STEM graduates in Arab countries coincide with lower mathematics anxiety (Alghneimin et al., 2023; Malallah et al., 2023; Matta, 2022).

For a subset of 50 countries with data for 2010–11 and 2020–21, there has been no change in the share of STEM graduates who are female. There are some notable examples of stagnation, such as Chile where the share has remained constant at 20%. The three countries with the largest fall in the share in this 10-year period were already well above average. The country with the largest fall among those with an initial position below average was Hungary (by 5 percentage points to 29%). At the opposite end, the three countries with the largest increase were North Macedonia (from 40% to 50%), the Netherlands (from just 21% to 31%) and Morocco (from 39% to 49%) (**Figure 24**).

FIGURE 23:

On average, only 35% of STEM graduates are women

Share of female STEM graduates, selected countries, 2022 or most recent year

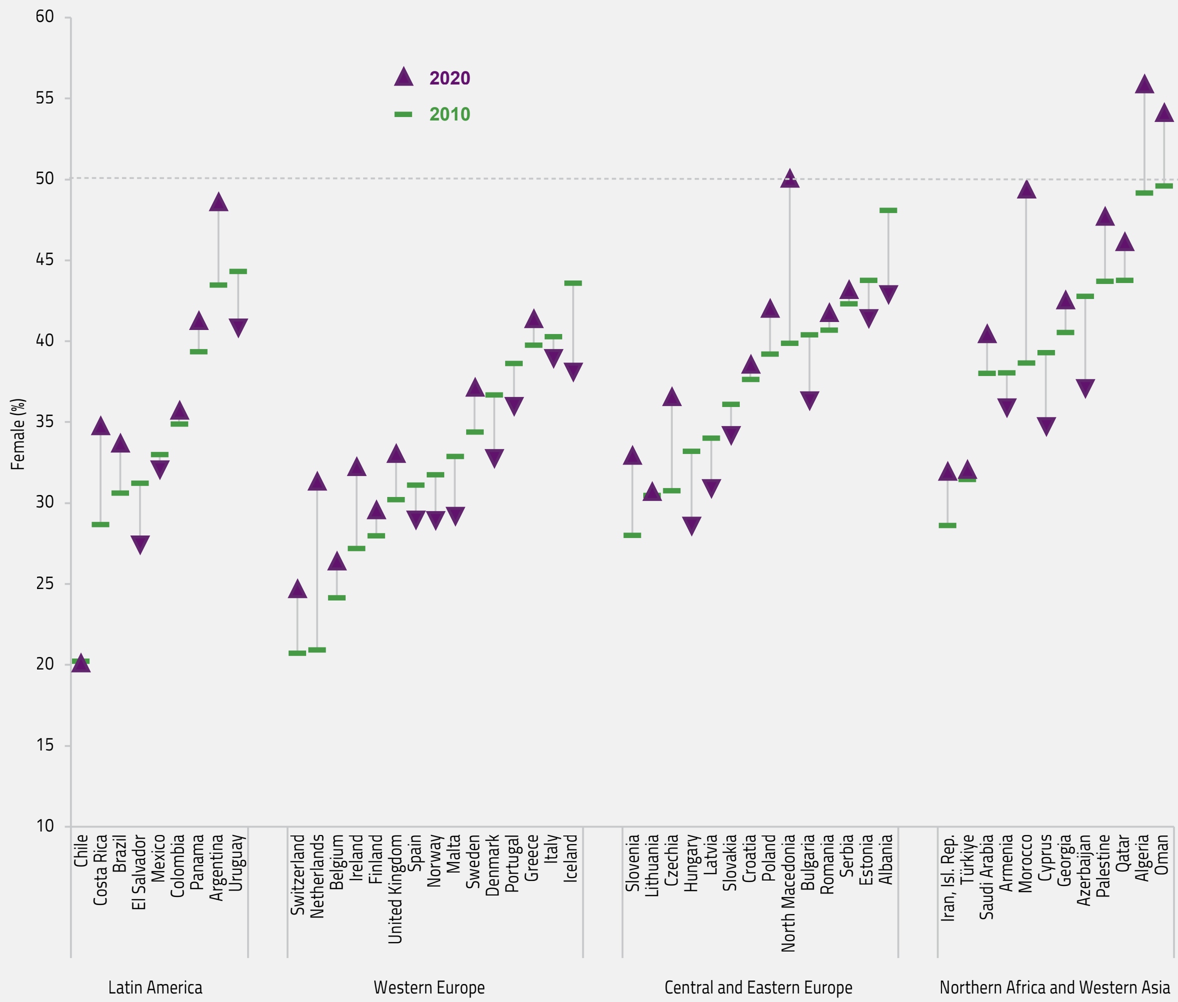


Source: UIS database.

FIGURE 24:

There has been no progress in 10 years in the share of females in STEM graduates

Share of female STEM graduates, selected countries, 2010–11 and 2020–21



Source: UIS database.

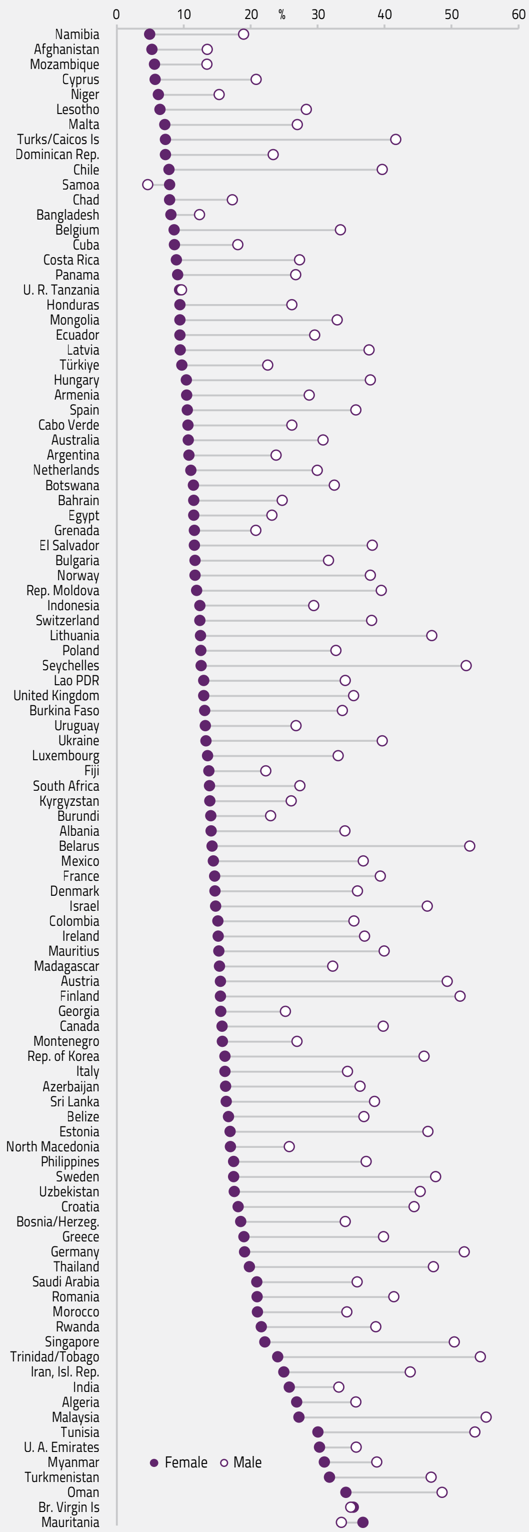
Bundling all STEM subjects together hides some variation. In 2016–18, women represented 28% of engineering, manufacturing and construction tertiary graduates and 30% of ICT tertiary graduates, but 57% of natural sciences, mathematics and statistics graduates (ranging from less than 20% in Bangladesh, Burkina Faso and Burundi to more than 80% in Bahrain, Maldives and the United Arab Emirates). In Saudi Arabia, 70% of students completing a degree in natural sciences, mathematics and statistics were women in 2019, compared to only 4% in engineering, manufacturing and construction. In Latin America and the Caribbean, women represented at most 40% of the STEM graduates but made up only 31% in engineering, manufacturing and construction and 18% in ICT (ECLAC, 2023a).

As young women are more likely to graduate from university in the majority of countries, the share of females in the total number of STEM graduates is slightly misleading. A closer look shows that the gender gap in tertiary field choices is starker. Only about 15% of young women choose STEM over other courses whereas the corresponding share of young men is 35%. Countries with very large absolute gaps in excess of 30 percentage points include Finland, Germany and Sweden. Countries with very large relative gaps include Belgium, Latvia and Spain. In contrast, Mauritania, Samoa and the United Republic of Tanzania are among the few countries with no gap (**Figure 25**).

FIGURE 25:

One in three young men but only one in six young women choose STEM courses

Share of STEM graduates out of total graduates, selected countries, by sex, 2022 or most recent year



Source: UIS database.

BOX 10:

Gender gaps in STEM choices crystallize in the labour market

Social biases and stereotypes exacerbate the gender divergence in study choices, contributing to women's lower participation in STEM careers. According to PISA data, less than 0.5% of 15-year-old girls compared to 5% of boys aspire to become ICT professionals in OECD countries. Boys are also, on average, more than twice as likely as girls to want to work as engineers, scientists or architects (OECD, 2017, 2019). Globally, less than one third of the world's researchers were women in 2021 – and as low as 24% in East Asia and the Pacific (UNICEF, 2023b). Women held less than 25% of science, engineering and ICT jobs in 2022 (UN Women, 2023). It has also been estimated that women occupy just over one in five technology positions in companies (McKinsey & Company, 2024). Responses from 17 universities that completed the Stanford University AI Index survey suggested that in 2020 only 16% of all tenure-track faculty whose primary research focus area is artificial intelligence and only 21% of new artificial intelligence PhD graduates were women (Stanford University, 2023). In 2022, 17% of patent applications were filed by women globally (UN Women, 2023).

A recent study has shown that taking a high-quality computer science course in secondary school increases the likelihood of majoring in computer science by 10 percentage points and receiving a bachelor's degree in that subject by 5 percentage points (Liu et al., 2024). In the United States, men are more likely to choose a STEM major, which accounts for more than half the total gender gap in STEM careers (Speer, 2021). A shortage of 1.4 million to 3.9 million technology professionals by 2027 has been projected in the European Union (EU). Doubling the share of women in the technology workforce could help close this gap and potentially boost GDP by between EUR 260 billion and EUR 600 billion (McKinsey & Company, 2021, 2024). However, despite possessing equivalent qualifications, women often struggle to secure relevant technology-related employment (Okahana et al., 2018). In 2021, 49% of total employment in non-STEM occupations was held by women but only 29% in STEM occupations. In the EU, one in four women with a degree in information technology worked in digital occupations, compared with more than one in two men (World Economic Forum, 2023). In India, only 30% of women work in computing jobs even though they account for 45% of students enrolled in technology studies (UNESCO and EQUALS, 2019).

These imbalances mean that gender gaps persist in STEM careers (**Box 10**) and even among STEM teachers. The 2018 Teaching and Learning International Survey results showed that 31% of upper secondary school male teachers teach STEM subjects compared to 25% of female teachers. Large gender gaps were observed in Denmark (14 percentage points), Brazil (10 percentage points) and Slovenia (8 percentage points) (OECD, 2021).

GENDER AND SOCIAL IDENTITIES AND STEREOTYPES SHAPE STEM ASPIRATIONS

Education choices are influenced by gender biases and stereotypes. For instance, certain professional tasks are often associated with gender. This drives career choices, whether consciously or unconsciously (McNally, 2020). For instance, women express stronger preferences for people-oriented occupations and men for things-oriented jobs (Diekman et al., 2010; Hammond et al., 2020).

A study of 12,700 university students in Australia found that female STEM students were no less confident in their abilities than male students. Yet they were still less likely to continue their careers in STEM as they became aware of environments in which their expectations of a successful career would be diminished (Bennett et al., 2021). More attention needs to be dedicated to women's confidence and career development in tertiary STEM education and to overcoming the challenges to self-efficacy resulting from stereotyping and discrimination (Bennett et al., 2021; Dangar, 2021). In the United Kingdom, the 2019 Engineering Board Monitor showed that girls had low self-belief in their ability to do well in STEM even though they outperform boys in most STEM subjects in secondary school. Only 56% of girls aged 11 to 14 said that they could become an engineer if they wanted to, compared with 71% of boys. The share falls further among 16- to 19-year-old girls (53%) (Armitage et al., 2020). In Viet Nam, girls were more likely not to choose ICT studies or careers even if they liked STEM subjects (UNESCO, 2020c).

Analysis of China Education Panel Survey data on the relation between mathematical capabilities and gender stereotypes showed that more than 5 in 10 students and 4 in 10 parents agreed that boys were better at mathematics than girls. While these stereotypical views are more present among male students (60%) and their parents (44%) than female students (44%) and their parents (35%), as many as 44% of girls and more than 3 in 10 parents of female students also shared this view. Boys who agreed with the statement that boys are better at mathematics had significantly higher scores on the mathematics test than their male peers who disagreed, while girls who agreed with this statement scored worse than their female peers who disagreed – suggesting a negative and inhibitory influence of such perceptions on achievement (Xie and Liu, 2023).

An evaluation in France watched children who had to memorize a geometric figure and then redo it. One group was told it was a geometry test and the other was told it was a drawing test. Girls who thought they were taking a drawing test performed significantly better than those who thought they were taking a geometry test (Spinelli and Hancewicz, 2021).

Gender stereotypes about STEM studies and professions are generated and perpetuated at home and in school (Ing, 2014; Xie and Liu, 2023). Emotions relating to social relationships with parents, teachers and peers, as well as to cultural goals such as a desire to go to university, influence student motivation for trying to solve a mathematics problem. Emotions also guide cognitive steps, leading towards a solution or away from it (Immordino-Yang and Fischer, 2010). Lack of support at home and from peers, low expectations from parents and teachers, and their perceptions of the appropriateness or safety of career choices reinforce horizontal gender segregation (UNESCO, 2022a), which helps explain why so few girls pursue a career in technology (Cheryan et al., 2017; Stoet and Geary, 2018).

A lack of self-belief in terms of mathematics and science aptitude limits girls' and women's STEM aspirations (Sheldrake, 2016), much more than their performance (DeWitt et al., 2013). A survey of more than 2,000 girls aged 15 to 19 in the Asia-Pacific region suggested that only 12% continued to study STEM subjects even though more than 50% were considering them when they were younger. The decisions were taken because of perceptions of gender bias, subject difficulty and lack of support from parents and teachers (Mastercard, 2018). If girls and young women are more likely to suffer from mathematics anxiety than men, mothers may also be more anxious than fathers and more likely to communicate this to their children, particularly daughters (Luttenberger et al., 2018).

A survey of 8,000 Chinese students in more than 200 lower secondary school classrooms also found that more than 50% of students believed that boys were innately better at mathematics than girls. However, views varied widely. In some classrooms, such beliefs were shared by fewer than one in five students, while in others by almost everyone. To test the beliefs, an experiment was run with 500 students. Before a mathematics test was to be administered, half of the students watched a video showing statistics that suggested men performed better than women in mathematics and were more likely to be in the top percentile of performance. The other half watched a video that never mentioned gender differences. Women in the first group did much worse than girls in the second group, implying the power of stereotypical influences (Wu, 2023).

Young women may be discouraged from taking STEM subjects if their peers view these subjects as inappropriate for girls (Robnett and Leaper, 2013). In Denmark, a study on the gender composition of high school peers in the mathematics track shows that having a mother who is STEM-educated helps mitigate potential negative peer effects (Brenøe and Zölitz, 2020).

TEACHER AND TEXTBOOK BIASES CAN NEGATIVELY AFFECT GIRLS' ASPIRATIONS

Female teachers can positively influence aspirations towards STEM by acting as role models (IEA and UNESCO, 2021). Using variation in student test scores across four science subjects (biology, chemistry, physics and earth science), a study based on 2015 TIMSS data found that teachers with subject-specific qualifications had a positive impact on test scores, and such impact was even higher for disadvantaged students and female students, while effects were even larger with a female teacher. The positive effects on student performance in science was roughly equivalent to an increase in weekly instruction time by two hours. One fifth of the effect was attributed to teacher confidence (Freundl and Sancassani, 2023).

Teachers may not always have a positive influence, however. In Latin America, 8% to 20% of maths teachers reported believing that their subject is easier for boys (Treviño et al., 2016). The latest OECD PISA 2022 found, for example, that male students reported greater teacher support than female and gender-diverse students. Moreover, learners in girls' schools reported significantly lower teacher support than learners in co-educational or boys' schools (Medina, 2023).

Teacher beliefs impact on girls' self-efficacy and in turn on their choices. In Italy, a study showed that female students scored worse on standardized tests when their mathematics teachers held strong implicit gender stereotypes (Carlana, 2019). Teachers' biases in favour of boys in science classes in Greece negatively affected the scores of girls (Lavy and Megalokonomou, 2019). Studies in France and Israel found that teacher biases in favour of boys affected the performance of boys and girls on tests (Lavy and Sand, 2018; Terrier, 2015). Data from the Young Lives studies from 205 schools across two states in India suggest that when they are taught by a male teacher with stereotypical beliefs, girls are more likely to develop a negative attitude towards mathematics (Rakshit and Sahoo, 2023). A study of grade 10 students in rural Limpopo, South Africa, shows that negative classroom experiences, such as educators' remarks, as well as a lack of science resources, were dissuading girls from choosing STEM subjects (Kibirige et al., 2022).

In rating identical transcripts, school counsellors in the United States were less likely to recommend Black female students for advanced placement in calculus classes, assigning them nearly the same scores as less prepared students (Francis et al., 2019). While primary and lower secondary school teachers in the United States seemed to disagree with the idea of innate mathematical ability, teachers who believed that 'mathematics require brilliance' tended to think 'girls lacked this ability' (Copur-Gencturk et al., 2021).

Biased gender norms and stereotypes embedded in curricula and textbooks influence girls' choices of what to study and what careers to pursue, risking the reproduction and reinforcement of traditional, discriminatory gender norms that negatively impact students' interests and aspirations. Men are more likely to be represented in textbooks as science professionals, by name or in illustrations, while women are more likely to be depicted in care occupations (Kerkhoven et al., 2016; UNESCO, 2020a). Children are likely to internalize these stereotypes, which influence their attitudes and aspirations (Hammond et al., 2020).

COUNTRIES ARE TRYING TO REDUCE GENDER DISPARITY IN STEM

Countries are adopting various approaches to address gender divides. Globally, 68% of the 211 education systems reviewed as part of the PEER country profiles for the 2023 *Global Education Monitoring Report* have policies in place to support STEM education, although only half of these policies specifically support girls and women. For example, Australia launched the Advancing Women in STEM Strategy in 2019 to support women in STEM careers and make women in STEM visible (Australian Government, 2022).

Many sub-Saharan African countries have such a focus, such as Rwanda (**Box 11**). In Kenya, the Ministry of Education has organized ICT and STEM bootcamps in schools aimed at encouraging and empowering girls to pursue STEM studies and careers (Kenya News Agency, 2023). In Namibia, Objective 4 of the National Science and Technology Innovation Policy stipulates the need to improve gender equality and mainstreaming in STEM and to establish and improve programmes that support women's participation in science education, science careers and as leaders and decision makers (Zelezny-Green and Metcalfe, 2023). Zambia's Technical Education, Vocational and Entrepreneurship Training Authority has established a platform that offers free digital skill courses targeted, among others, at women (Zambia TEVETA, 2023).

Efforts to bridge the large gender divide are also underway in South Asia. In Bangladesh, the Eighth Five Year Plan 2020–25 has a dedicated section on STEM and ICT education for girls and emphasizes scholarships, job counselling, advocacy and parent–teacher conferences to promote STEM (Bangladesh Planning Commission, 2020). In India, the Department of Science and Technology implements the Women in Science and Engineering-KIRAN (WISE-KIRAN) programme to enhance female participation. During its G20 presidency, India launched the TechEquity platform to empower women with digital literacy skills (India Ministry of Child and Women Development et al., 2023). The STEM Stars campaign promotes science and technology education with a focus on training rural and marginalized women. In Pakistan, the Universal Service Fund supports the ICT for Girls initiative, which has equipped 144 women empowerment centres and 226 schools in Islamabad with ICT Model Labs to improve girls' computing skills in partnership with the private sector (Pakistan Ministry of Information Technology and Telecommunications and Universal Service Fund, 2019). This initiative responds to one of the objectives in the 2018 Digital Pakistan Policy to empower women and girls through ICT and reduce gender barriers in technology adoption (Digital Pakistan, 2020; Pakistan Ministry of Information and Broadcasting, 2018).

Most countries in Southeast Asia have committed to promoting STEM for women. In Cambodia, Sisters of Code conducts an 18-week programme in creative computing, targeting girls aged 10 to 20 attending public schools, to influence community perceptions by engaging parents, organizing graduation events and enlisting youth ambassadors within the community. In Indonesia, Generation Girl introduces girls to STEM disciplines from a young age through engaging initiatives, including holiday clubs and hackathons. Female role models and mentors play an active role, offering additional support and serving as sources of inspiration for the girls. In 2021, Singapore launched the Promotion of Women in Engineering, Research and Science (POWERS) programme to increase gender diversity in STEM fields through recruitment, research, education and skills training for women (Teng, 2021). The programme also conducts research to address diversity barriers and provides education and skills training for career advancement in STEM for women (Singapore Nanyang Technological University, 2024).

A recent analysis in Latin America and the Caribbean found that few countries included a gender dimension in their digital education strategies (Trigo and Valenzuela, 2022). Colombia launched the ICT Women for Change programme to provide digital training to 10,000 women. In 2019, the Colombian Institute for Family Wellness launched the Pequeñas Aventureras (Little Adventurers) programme targeting 4- to 5-year-olds in 661 community-based preschool programmes, training mothers on the use of a digital toolkit, aiming to reduce gender and race stereotypes among instructors and raise children's interest in STEM (Inter-American Development Bank, 2022; Naslund-Hadley and Hernández-Agramonte, 2020). Costa Rica's national broadband plan emphasizes women's access. The National Policy for Equality between Women and Men in Training, Employment, and Enjoyment of the Products of Science, Technology, Telecommunications, and Innovation (2018–2027) seeks to tackle the challenges and barriers women encounter in the scientific and technological fields (Costa Rica Minister of Science Technology and Telecommunications, 2017).

Many Arab countries also promote gender initiatives in their strategies and plans. Jordan initiated a Youth, Technology and Jobs project to deliver professional digital skills programmes to 30,000 youth and women in 2020–25. It also aims to create 10,000 new jobs for young women and Syrian refugees in digital freelancing and content creation (Jordan Ministry of Digital Economy and Entrepreneurship, 2023).

BOX 11:

Rwanda has several initiatives promoting STEM for girls

As well as making gender equity in technology a pillar of its national policy, Rwanda has implemented several initiatives to enhance girls' aspirations for STEM disciplines. Launched in 2011 as a civil society initiative, Girls in ICT aims to inspire more girls to join STEM fields. Between 2019 and 2021, the programme mentored 233 girls. In partnership with the Ministry of ICT and Youth, it also conducts awareness campaigns throughout Rwanda, mostly in secondary schools (Girls in ICT Rwanda, 2023). Girls in ICT also launched the annual Ms Geek Competition in 2014 to inspire women in university and technical education (UNESCO and UNESCO-UNEVOC, 2020). Renamed Ms Geek Africa, it is now present in 22 African countries (Ghana Ministry of Communications and Digitalisation, 2020).

The We Code initiative, a collaboration between the Rwanda ICT Chamber, an arm of the Private Sector Federation, and the University of Rwanda, offers coding training specifically tailored for girls (WeCode, 2019). The one-week Tech Kobwa Boot Camp is aimed at secondary school girls, particularly those from remote schools with limited access to technology and computers. The camp provides foundational programming knowledge, Internet usage and other essential computer skills, while it exposes participants to the benefits of technology through mentorship (Techkobwa, 2024). A 2016 evaluation of the project suggested that performance improved in several learning outcomes including algorithms, good writing, currents and diodes (Slattery, 2016).

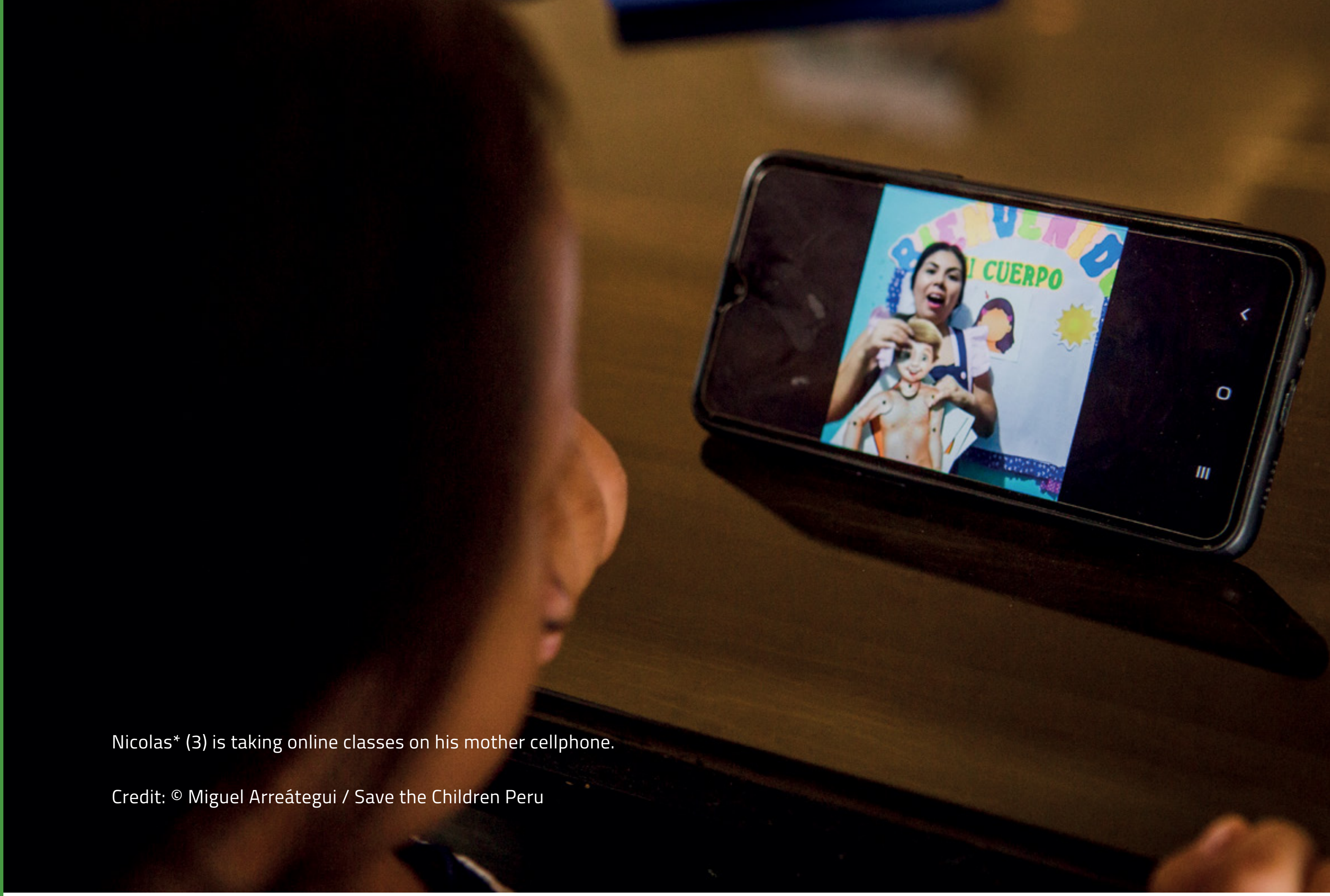
The Rwanda Coding Academy, established in 2019 in partnership with the Ministry of ICT, the Ministry of Education and Rwanda Polytechnic, is designed to provide coding training for software development and cybersecurity (Rwanda Coding Academy, 2024a). The first cohort comprised 28 girls and 32 boys. Admission by the Rwanda Education Board is based on test scores at the national examination (Rwanda Coding Academy, 2024b).

Hour of Code, promoted by Code.org, was launched in Rwanda in 2013 and provides students with the foundations of programming. Independent evaluations in other counties have shown that the course increases student interest in computer science and develops computational skills (Ali and Recep, 2021), but little is known about whether the activity leads to continued learning and access to advanced education (Vegas and Fowler, 2020).

Policies in Europe are driven by the EU Digital Decade 2030 goal that 80% of adults aged 16 to 74 will have at least basic digital skills and the objective to employ 20 million ICT specialists, with an emphasis on gender balance (European Commission, 2023b). Belgium's 2021 National Recovery and Resilience Plan emphasizes the need to address the considerable gender digital and STEM skills gap. As part of the Flemish community's STEM Action Plan 2012–2020, STEM teacher education and course material have been enhanced, resources have been shared through the Klascement website and a 'STEM monitor' helps assess progress. Ireland's 2024 Harnessing Digital – The Digital Ireland Framework and STEM Education Implementation Plan for 2026 aim to improve the gender balance in STEM-related activities.

Counselling and guidance services can help girls consider STEM pathways they would otherwise not have (Musset and Kureková, 2018). Role models and mentors have proved to increase girls' confidence in STEM and to influence their career aspirations (Hencke et al., 2022). Relevant information about education and job opportunities can help challenge existing career stereotypes. Female mentors can improve the culture of STEM workplaces (Male et al. 2018).

Since 2019, Canada has invested some USD 11 million to support the activities of the non-profit Let's Talk Science, which promotes STEM educational and occupational opportunities to teachers and students up to grade 12 through STEM career profiles and models (Let's Talk Science, 2022). In Gambia, the organization Women in Science, Technology, Engineering and Mathematics has set up STEM clubs in senior secondary schools and organizes outreach programmes to raise awareness among schoolgoing girls (WISTEM, 2022). In Kenya, the telecommunications company Safaricom launched a digital mentorship programme for secondary school students in partnership with UNESCO and the Eneza Foundation. Students receive information on STEM studies and career pathways from mentors and role models through radio, television and text messages (Safaricom, 2020). However, not all career counselling has a positive influence on reversing students' traditional choices. In the Netherlands, teaching staff and school career advisers tend to persuade more boys to choose STEM careers than girls, who sometimes even receive recommendations against doing so (UNESCO and UNESCO-UNEVOC, 2020).



Nicolas* (3) is taking online classes on his mother cellphone.

Credit: © Miguel Arreátegui / Save the Children Peru

Conclusion

This report has provided further evidence on the long-term trend which has seen more girls than boys completing each schooling level, in country after country.

When asked, as part of the SDG 4 benchmarking process, to set national targets for 2025 and 2030, more than two thirds of countries had set national targets for the secondary completion rate. But only just over one third of countries set a target on the gender gap of the secondary completion rate, the lowest rate of all benchmark indicators, despite the fact that less than one quarter have achieved parity.

Analysis of countries' progress towards countries' national gender gap targets in the SDG 4 Scorecard showed that, in the 27% of countries where fewer young women than men were completing upper secondary school in 2015, the gender gap in completion rates had fallen from 6.9 percentage points to 2015 to 4.2 percentage points in 2022; in other words, these countries were moving towards parity, albeit slowly. But in the 49% of countries where fewer young men than women were completing upper secondary school in 2015, the gender gap in completion rates had increased from 6.8 percentage points in 2015 to 9.5 percentage points in 2022, moving further away from parity. It is perhaps not surprising that many countries are not committing to parity targets when they know that they are struggling to address the new challenge that fewer boys than girls complete secondary school.

This example shows that we need to view issues of gender parity in education access and completion in a new light. This report offers three perspectives.

First, there remain considerable pockets of gender-based exclusion from education in sub-Saharan Africa, the only region not to have achieved gender parity in primary, secondary and tertiary enrolment, especially in rural and poor communities. Progress is being made despite considerable discriminatory norms: even in sub-Saharan Africa, gender parity has already almost been achieved in lower secondary completion among those who complete school on time. But only 85 girls ultimately complete lower secondary for every 100 boys; and only 78 girls ultimately complete upper secondary for every 100 boys who do so. Because of late entry and repetition, problems that are more acute in Africa than in the rest of the world, when girls reach the age of 15 and have still not reached the end of lower secondary school, they are more likely to drop out, faced with expectations of marriage and childbirth. If boys and girls started school on time and did not repeat grades, so that they would not be too old for their grade, then the region could make significant progress in addressing remaining disparity in secondary education access and completion.

Second, despite girls' advances in reading, science and mathematics, the persistent pattern of gender gaps eventually affects girls' study and career choices, showing where attention must be paid. Girls outperform boys in reading in practically every country in the world. They have also achieved parity in science and mathematics at the global minimum proficiency level. But they are considerably lagging behind boys in science and, especially, in mathematics at higher levels of proficiency. There are also large gender gaps in programming skills. The report documents that, in almost all countries in the world, with the exception of Arab countries, girls are more likely to feel more anxious about mathematics than boys. Research has established that this has a negative impact on their performance. Worse, teachers and parents often exacerbate these feelings, with adverse consequences on girls' subject and, ultimately, career choices, which take them away from science, technology, engineering and mathematics. New evidence shows that there was no progress globally between 2010/11 and 2020/21 in the percentage of women among STEM graduates, which has remained stagnant at 35%. Women held less than 25% of science, engineering and ICT jobs in 2022. In another example, in the United States, only 16% of all tenure-track faculty whose primary research focus area is artificial intelligence are women. There are, therefore, serious risks that the existing gender biases affecting technological transformation will persist.

Third, more attention is needed to the role of education in influencing gender bias in technology. In principle, technology offers learning opportunities that could overcome certain obstacles, for example in accessing reliable information on comprehensive sexuality education in a safe and confidential environment. But in practice, technology seems to be posing more risks in the opposite direction. Nowhere is this more evident currently than in the way the use of social media affects girls' well-being and safety, and reinforces gender norms. Algorithms target teenagers far too often with content related to body image and mental health. Greater interaction on social media at age 10 is associated with socioemotional difficulties that worsen with age among girls, while no cross-associations were found among boys. Technology allows for cyberbullying, including through image abuse, which is more common for girls. Ultimately, emotional well-being is linked to better academic outcomes. As is proposed in the recommendations below, education urgently needs to be protected from the negative influences of technology.

Inequality in the design, access, pedagogies and skills related to digital technology in education should be addressed to ensure that every girl can benefit from the opportunities that such technology can afford. Technology's benefits must be harnessed in ways that explicitly address and reduce gender disparities. Ensuring a supportive environment for women and girls to own and use digital tools and to pursue STEM subjects and careers will lead to a digital transformation that fosters – and does not create additional barriers to – gender quality in education and beyond.

RECOMMENDATIONS

As the 2023 *Global Education Monitoring Report* has highlighted, there are four questions to be addressed in deciding whether a technology should be implemented. Is it appropriate? Equitable? Scalable? Sustainable? These same questions are even more relevant for interventions for girls, especially marginalized girls. The answers to the questions provide a guide to leveraging technology as a catalyst for gender-equitable education.

Make sure the selected technology application is relevant and appropriate:

- Design, monitor and evaluate education technology policies with the participation of multiple stakeholders so that their inputs contribute to a more nuanced understanding of how technology can serve as a vehicle for gender-inclusive educational reforms and practices.
- Design relevant curricula and teacher training that address gender stereotypes and negative gender norms that may be reinforced through the use of technology.
- Promote female leadership in artificial intelligence and technology development in order to assure gender-sensitive digital transformation and address gender stereotypes in algorithms.

Make sure the selected technology application does not leave anyone behind:

- Focus on how digital technology can support the most marginalized so that all can benefit from its potential, irrespective of background, identity or ability, and ensure that digital resources and devices comply with global accessibility standards.
- Adopt various approaches to close the gender digital divide in accessing and using technology. Avoid infrastructure-only approaches and invest in gender-responsive education and training programmes to enhance digital literacy and skills for all. Work with parents to address social norms holding back girls' freedom of access and use of technology.
- Invest in programmes that can empower girls and young women to study in STEM fields and pursue STEM careers in order to encourage non-discrimination and gender balance in technological design.

Make sure the selected technology application is scalable:

- Establish bodies to evaluate education technology and algorithms, setting clear evaluation standards and criteria, to assess where they may be amplifying negative gender stereotypes or gender norms or negatively affecting well-being.

Make sure the selected technology application is sustainable:

- Establish a framework of digital competences that provides guidance for the skills all learners should acquire, no matter their gender, including skills for young learners to protect themselves against the proliferation of violence when online.
- Adopt and implement legislation, standards and agreed good practices to protect learners' and teachers' well-being, online safety and privacy from a gender perspective.
- Hold education technology companies responsible for ensuring safe learning environments, assessing the risks of their products and developing upstream solutions to protect learners' well-being, through human content moderation and better addressing user complaints.

2024 GENDER REPORT

Technology on her terms

Midway to the deadline for the 2030 education targets, the 2024 Gender Report assesses the progress made towards achieving gender parity across all levels of education. While examples of stubborn exclusion remain, the report tells a positive story at the global level for girls' access and education attainment over the past two decades.

A companion edition to the 2023 GEM Report, *A tool on whose terms?*, this report asks in what circumstances technology is helping to promote gender equality in education. While in some instances, technology can provide a lifeline for girls otherwise excluded from education altogether, there remain gender divides in access to technology and the acquisition of digital skills.

Technology can also facilitate access to valuable content, such as comprehensive sexuality education, access to which is often constrained. But in calling for technology to be 'on her terms', the report challenges countries to interrogate when technology puts safe learning environments at risk, and whether the design of some technology is entrenching negative social norms and gender stereotypes into children's and young people's everyday lives.

The extent to which girls are encouraged and empowered to build on their mathematics skills in their early years to take them through to science, technology, engineering and mathematics (STEM) studies and, ultimately, STEM careers is suggested as key to ensuring that technological design will work for everyone in the future. The report posits that education has a critical role to play in determining if digital transformation will lead us to a gender-balanced future.

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