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CHANGING THE EQUATION

Securing STEM futures for women

Policy Brief for the G20 Women's Empowerment Working Group

Published in 2024
by the United Nations Educational, Scientific and Cultural Organization (UNESCO)
7 place de Fontenoy, 75352 Paris 07 SP, France

ISBN 978-92-3-100704-0

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Illustration: © Keith Negley c/o Theispot

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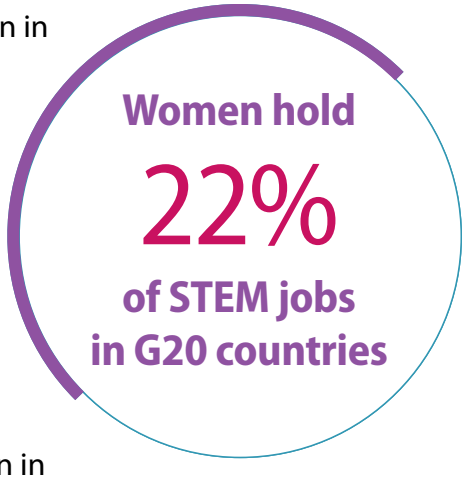
Printed by UNESCO.

SHORT SUMMARY

Making STEM possible and worthwhile for women and girls in G20 countries

Science, technology, engineering and mathematics (STEM) are seen as the fields of the future, with expanding job opportunities creating the goods, services and innovations that shape our daily lives.

Yet women and girls form a third or less of the students, employees and innovators in these fields. When they do work in STEM, women earn 85% or less of what men are paid, and they are more likely to be the target of gender-based violence and sexism than women in other fields. Virtually no progress has been made in the past two decades.



Women and girls remain less likely than men and boys to advance to the next stage of their education or career in STEM, despite equal capacity. To close the gender gap, STEM studies and careers must be made possible and worthwhile, as a competitive choice for girls and women.

This policy brief identifies mechanisms to improve women's and girls' aspiration, participation and retention in STEM fields, from early education through to careers, illustrated by actions within G20 countries.

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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 defences of peace must be constructed"

Policy Brief for the G20 Women's Empowerment Working Group

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CHANGING THE EQUATION

Securing STEM futures for women

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KEY MESSAGES

- From an early age, **women and girls face persistent gender inequalities and systemic barriers in fields related to science, technology, engineering and mathematics** (STEM) in G20 countries, particularly in advanced stages along the career ladder. These inequalities exist despite strong performance in STEM by women and girls.
- **No progress has been observed in the past decade in the proportion of women who study and graduate in STEM subjects.** Women formed a third or less of STEM graduates in most G20 countries in 2022. It is critical to tackle gender inequalities in STEM education and career counselling as girls are significantly less likely than boys to aspire to or pursue STEM studies in most countries, even though gender disparities in performance in science and mathematics are small and decreasing.
- **There are two-fold fewer women in STEM occupations than in the overall workforce**, with no significant improvement in representation over the past two decades in G20 countries. The proportion of women has diminished among ICT professionals and technicians since 2005. Women are outnumbered in higher education and in career and leadership roles in STEM. Underrepresentation moves them to the margins including among the decision-makers shaping STEM today and into the future.
- **Gender bias – not performance – prevents women from entering and progressing in STEM careers.** According to the Gender Scan survey (2021), 40% of women studying STEM reported they were the target of sexist behaviour, and nearly half of women working in STEM reported having experienced sexism at work. Fair and equitable pay is not yet a reality in STEM: Women's pay was less than 85% of men's pay in STEM occupations in 8 of the 10 G20 countries with data. Among researchers, women are less likely than men to obtain grants and receive smaller amounts when they do. Dismantling systemic inequities is essential to end the observed attrition along career pathways in STEM.
- **Retention depends on conditions within STEM institutions and workplaces**, affected by both procedural and cultural factors. In particular, women are more likely than men to interrupt their careers to fulfil caregiver responsibilities. The evidence underscores the importance of targeted interventions and supportive policies in achieving gender equality in STEM education and careers.
- Attracting girls and women to STEM is just the beginning. Understanding what they face – and why they leave – requires more information. **Gender-disaggregated data, comparable across countries, are foundational for decision-making but remain limited.** For instance, less than two-thirds of universities track women's graduation rates and have plans aimed at closing the gender gap, even though four in five universities track gender in application rates.
- **The global community would benefit from combatting gender inequalities in STEM** both to permit the expression of the human right to science and to help us achieve global goals and overcome global challenges. The lack of gender equality in STEM can impede national development. By missing out on half of the world's potential, all of society suffers because its ability to address challenges and take advantage of innovations is undermined.

Women and girls in STEM fields face disparities in the G20 countries

In **8 of 10** countries more **boys** aspire to jobs using **maths**

(TIMSS, 2019)

Only **1 in 3** researchers is a **woman**

(UIS, 2021)

Women account for **35%** of **STEM tertiary graduates**

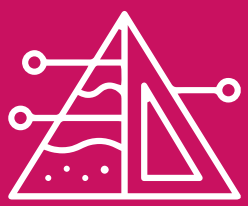
(OECD, UIS, Eurostat, 2023)

Less than **25%** of **inventors** listed in international patents are **women**

(WIPO, 2023)

Women hold **22%** of **STEM jobs**

(ILOSTAT, 2005, 2015, 2021)



Women in STEM occupations earn just **85%** of **men's pay**

(ILOSTAT, 2021)

INTRODUCTION

Addressing persistent gender inequalities in STEM

UNESCO, the United Nations organization with the mandate for education, sciences, culture and communication, implements its Global Priority Gender Equality since 2007 by providing solutions to reduce inequalities in and through education, empowering women in science and technology, promoting inclusion and combating gender-based violence, bridging the digital gender divide and supporting women's empowerment in crisis, emergency and early recovery contexts.

Building on the G20 Leaders' Declaration in New Delhi in 2023, the G20 Working Group on Women's Empowerment aims to support G20 countries to tackle gender inequalities, which also boosts progress towards the achievement of Sustainable Development Goal 5 and related goals. This policy brief is part of UNESCO's contribution to the G20 Working Group on Women's Empowerment.

Taking a comprehensive approach addressing the evidence base of trends in science, technology, engineering and mathematics (STEM) from early education through to careers, as well as the professional and personal experiences of STEM students and professionals, this brief summarizes opportunities for public policy to close the gender gap in STEM fields in G20 countries and beyond.

The pathways of girls and women in STEM fields in G20 countries demonstrate that almost no advance has been achieved in the last two decades. Despite demonstrated capabilities, girls and women are more likely to leave STEM and less likely to be represented in leadership roles.

This brief is an invitation to enhance actions for gender equality in STEM grounded in robust evaluation. Examples of innovative policies, measures and initiatives in G20 countries are shared alongside recommendations to make the difference for an inclusive and sustainable future.

As part of holistic action across society, the targeted implementation of national policy tools can create a more inclusive and equitable environment for all aspiring and current STEM students and professionals across the G20 countries and thus help to accelerate the achievement of the Sustainable Development Goals. Evidence-based solutions can be designed by identifying what attracts or deters girls and women within these fields and by recognizing the gender-based factors underpinning entry and retention in STEM.

Scope and methodology

This document presents recent trends, challenges and opportunities for integrating and empowering women and girls in the STEM fields, from school to the workplace. It covers the G20 countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Republic of Korea (ROK), Russia, Saudi Arabia, South Africa, Türkiye, the United Kingdom of Great Britain and Northern Ireland (UK) and the United States of America (USA), as well as the European Union (EU) and the African Union (AU), using the sex-disaggregated data publicly available.

Quantitative representation and performance metrics illustrate the participation of girls and women at progressive stages throughout STEM education and careers. This brief was built from a desk review focused on internationally comparable statistics from UNESCO, International Labour Organization (ILO), Organisation for Economic Co-operation and Development (OECD) and World Intellectual Property Organization (WIPO), in combination with national statistics and data extracted from the scientific literature. An up-to-date analysis of the educational and professional landscape within STEM concerning gender (in)equality in the G20 countries is presented using the most recent data, with comparisons over the past two decades where possible.

In addition, firsthand accounts from students and professionals in STEM are used to pinpoint the motivators and barriers that influence their educational and career trajectories, using information from the Gender Scan Survey.

The survey covers a wide range of factors that influence gender (in)equality in STEM, such as discouragement of girls from entering STEM studies, barriers for women during STEM studies and for women graduates to pursue STEM careers, harassment and sexism, and the availability of supportive workplace policies and practices. Additionally, it aims to capture perceptions of how gender affects university and workplace dynamics to assess what interventions would be more supported and thus more effective to tackle specific challenges.

Conducted biennially since 2016, the Gender Scan Survey is unique in seeking responses from adolescents through to established professionals, enabling analysis from school to professional life and providing a longitudinal view of common themes and challenges over time. In partnership with Global Contact, UNESCO has launched the 2024/25 Gender Scan Survey to collect and analyse data from students and professionals aiming to identify key levers for progress towards gender equality in STEM. The statistical analyses will be available in 2025. Preliminary responses from 182 students from two G20 countries and 1,331 professionals from five G20 countries have been collected as of 15 September 2024.[1] By broadening the reach of these surveys, new data could be gathered to inform policies contributing to a more inclusive and equitable STEM landscape.

The pathways of girls and women in STEM fields in G20 countries demonstrate that almost no advance has been achieved in the last two decades.

Survey for students

Survey for professionals

The latest Gender Scan Survey, launched in May 2024 and open through early 2025, can be completed in English, French, Portuguese or Spanish by students (*https://stu2024.genderscan.org/*) and professionals (*https://gen2024.genderscan.org/*) in STEM fields.

THE STEM GAP

Why does a gender gap in STEM matter?

By missing out on half of the world's potential, all of society suffers because our ability to address challenges and take advantage of innovations is undermined. The G20 countries and the international community would benefit from combating gender inequalities to find solutions to common challenges, accelerate the achievement of global goals and advance the fulfilment of the human right to share in scientific advancement and its benefits.

A range of gains are provided by diversity, equity and inclusion, including in STEM. Such benefits include the greater innovation of diverse teams and the creation of an adequate STEM workforce with resulting economic potential, among others.[2]

Yet women and girls face persistent gender inequalities in STEM fields, particularly in advanced stages along the career ladder. For instance, women account for just one quarter of students in information communication and technology (ICT), one in three researchers and 10% of Nobel Prize awardees in natural sciences since 2011.[3] Women hold 22% of STEM occupations in G20 countries (Figure 3.1).

> ***I was discouraged from advancing in my academic career in STEM, due to low salaries and living standards, even at the PhD level. The work-life imbalance as a woman also made it hard to take on part-time jobs. However, I have joined scientific groups and learned how to pursue a better career path.***
>
> Woman, 33, PhD student in mathematics and statistics in South Africa (Gender Scan 2024)

Why is there a gender gap in STEM?

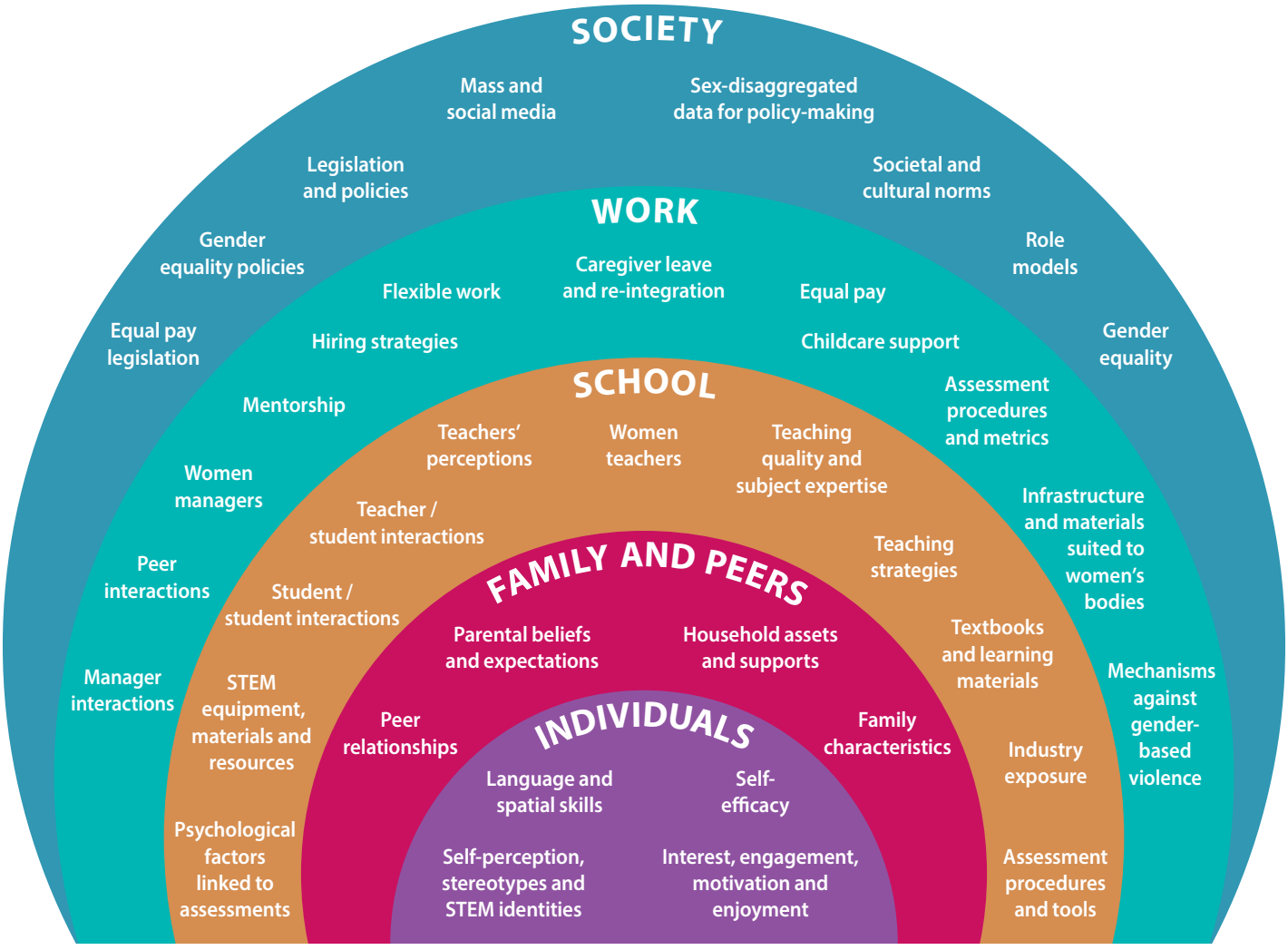
Multiple and overlapping factors influence girls' and women's participation, achievement and progression in STEM studies and careers, all of which interact in complex ways for girls and women in all their diversity. These factors are present from an early age, creating and perpetuating learned biases. Gender bias, which may be unconscious, creates gendered expectations and gendered interactions that can shape the motivation, interest and skills development of young children, students and professionals. Figure i.1 sets out a framework of factors at the individual, family, institutional and societal levels, building on the framework in the UNESCO report *Cracking the Code*.[4]

- **Individual level:** Differences in cognitive ability are more likely to differ among individuals than between girls and boys, women and men. However, individual beliefs, self-perception and experiences do shape STEM-related learning and participation. Self-efficacy affects STEM education outcomes and aspirations for STEM careers, as well as performance. Girls and women who assimilate gender stereotypes have lower levels of self-efficacy and confidence in their ability than boys and men.
- **Family and peer level:** Gendered parental beliefs and expectations, parental education and socio-economic status, behaviours by parents, relatives and partners around STEM-related play, learning and working, as well as peer influences impact girls' and women's motivation and sense of belonging in STEM.
- **School level:** Factors within the learning environment – including teachers' profile, experience and gendered beliefs and expectations; curricula, learning materials and resources including the presence of gender stereotypes and bias; teaching strategies and student–teacher interactions; assessment practices and the overall school environment – affect whether or not girls engage in STEM early and women pursue STEM career paths.

- **Workplace level:** Factors within the career environment, including hiring and advancement strategies, parental and caregiver leave, re-integration following family-related career interruptions, childcare support, flexibility of working arrangements, collegial interactions, presence of robust mechanisms for reporting and responding to gender-based harassment and violence, availability of equipment and infrastructure suited to women, gendered remuneration and the overall workplace environment, affect how women enter and experience the STEM workforce.
- **Societal level:** Social and cultural norms related to gender equality – as well as gender stereotypes in the media – influence girls' and women's perceptions about their abilities, role in society and career and life aspirations. Although policy interventions can influence or compensate for societal factors, many policies are gender-blind or gender-neutral, without mandating or supporting targeted actions or gender-disaggregated monitoring.

Figure i.1

Framework of factors influencing girls' and women's participation, achievement and progression in STEM



Source: Adapted from UNESCO (2017)

SECTION 1 Building early foundations in STEM

Even before formal schooling begins, pre-primary education and the experiences children have through play, socialization and early learning equip them to build spatial skills and self-efficacy, creating a foundation for future success in STEM fields.[5] These early experiences help children develop the cognitive and social skills necessary to succeed in primary school and beyond. Inclusion in pre-primary education is crucial to ensuring all children, regardless of gender, have equal opportunities to explore and develop an interest in STEM fields.

At the primary and secondary school levels, addressing gender disparities in STEM education is crucial for fostering a diverse and inclusive talent pool. Trends in girls' performance, participation and advice received in STEM during these formative years reveal insights into the barriers and opportunities they face.

These patterns should inform effective strategies and policies to encourage and sustain girls' interest in STEM ensuring they are equipped with not only the skills but also the awareness and confidence needed to pursue higher education and careers in these fields.

Creating an enabling and inclusive STEM environment from an early age necessitates addressing challenges such as gender stereotypes and the availability of resources and infrastructure, promoting gender-transformative teaching, content and learning opportunities, embedding real-world relevance, while leveraging opportunities like visible role models, mentorship and extracurricular programmes.

1. Recent trends

Although fewer girls than boys are out of primary school, a gender gap persists at the end of secondary school

Over the past 20 years, gender disparities in enrolment have been in decline for both primary and secondary levels. **The majority of G20 countries show gender balance or fewer girls among those out of school.** The exceptions are Indonesia and several countries of the African Union (Figure 1.1). In absolute numbers, sub-Saharan Africa is the 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.[6]

Globally, 122 million girls (and 128 million boys) of primary and secondary school age are still out of school and getting every girl into primary school will not happen until 2050 at the present rate.[6] These children are thus deprived of the opportunity to access basic training, and their chances of joining the STEM sectors are significantly reduced or non-existent.

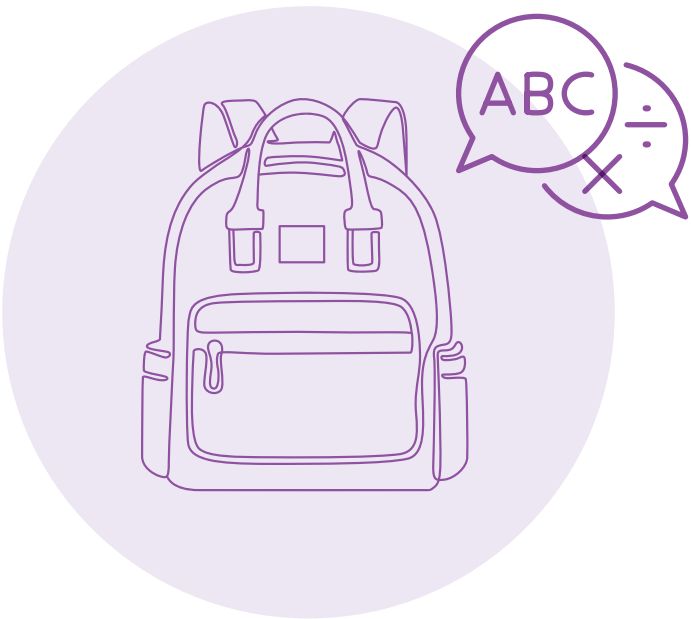
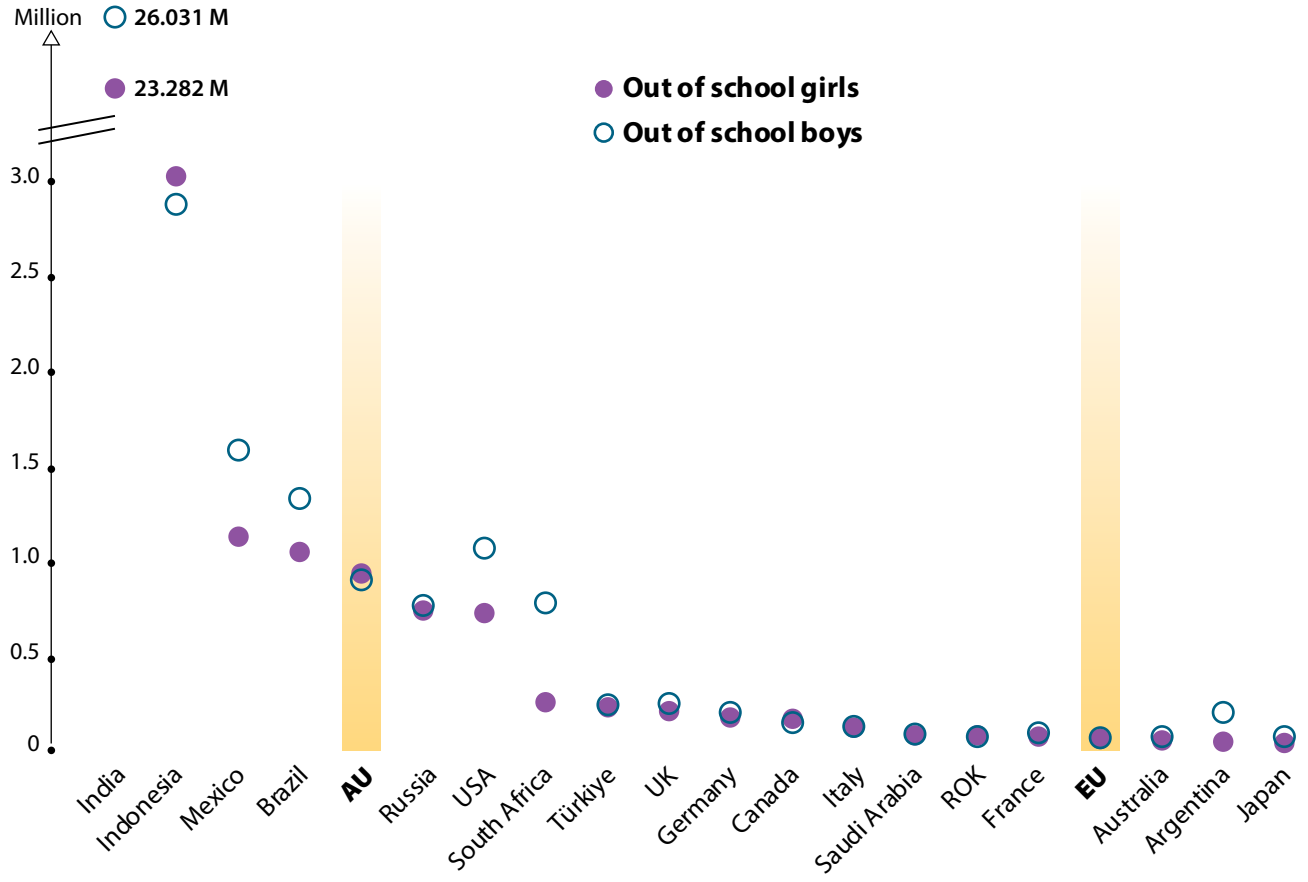


Figure 1.1 Out of school girls and boys of primary and secondary school age



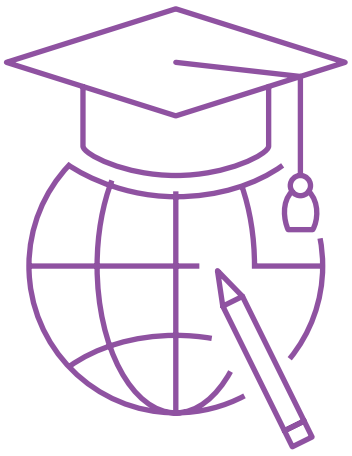
Source: UNESCO Institute for Statistics, 2024. Data for 2022 or most recent year[7]

Box 1.1

Are countries setting and achieving gender targets in education?

Considering global progress towards Sustainable Development Goal 4 (SDG 4) on inclusive education and lifelong learning, while 70% of countries have submitted a national target for improving their overall completion rate for upper secondary completion, only 36% have submitted a national target for addressing the gender gap in upper secondary completion. This is the lowest submission rate of all SDG 4 benchmark indicators.[8]

In total, nine of the G20 countries (40%) have set national benchmarks for reducing the gender gap in upper secondary completion. A 2024 assessment revealed slow or no progress in six G20 countries and a lack of data for two countries.[8]



Perceptions, rather than performance, shape career aspirations

Adequate training and performance in science and mathematics in primary and secondary education is foundational for future STEM pursuits. By the start of secondary school, the science and mathematics achievement of boys and girls are similar in many G20 countries, with girls outperforming boys in mathematics and science in some countries (Figures 1.2 and 1.3). However, boys are over-represented among the top performers in mathematics.[9]

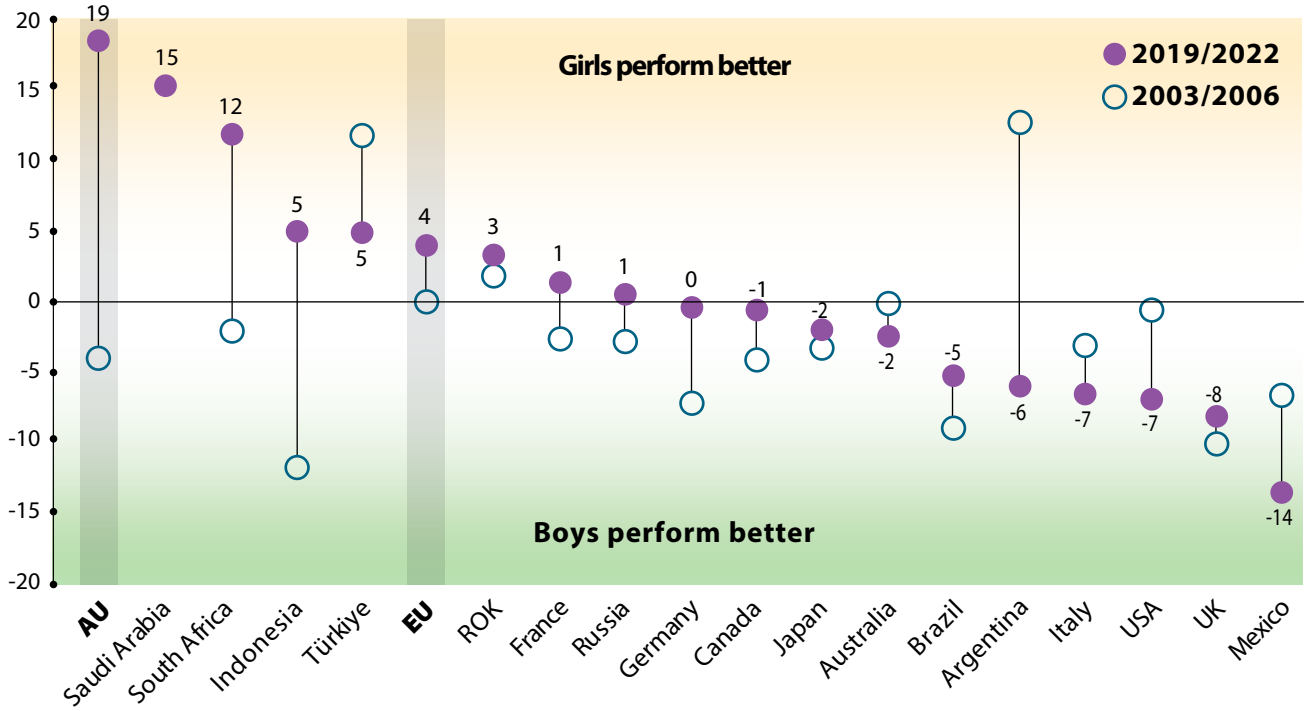
Although girls often perform on par with or better than boys in science in primary and secondary school, girls are less likely to express a desire to pursue STEM further, an inclination backed up by later choices (see Sections 2 and 3). For example, in eight of the ten G20 countries assessed in the Trends in Mathematics and Science Study (TIMSS 2019), boys responded significantly more often than girls that they would like to pursue a job that involves mathematics. The only exceptions were South Africa and Türkiye, where there were no significant gender differences.[9]

For both girls and boys, high confidence in mathematics or science skills is associated with a higher likelihood to want to pursue studies and/or to enter a job in mathematics or science. Boys are more confident in mathematics than girls at the start of secondary school.[9] This gender difference was less pronounced in science.

Lower confidence and aspirations could lead to fewer well-performing girls entering STEM tertiary education fields and jobs. This suggests that addressing the confidence of girls in science and mathematics should continue to be a priority for policy-makers.[10]

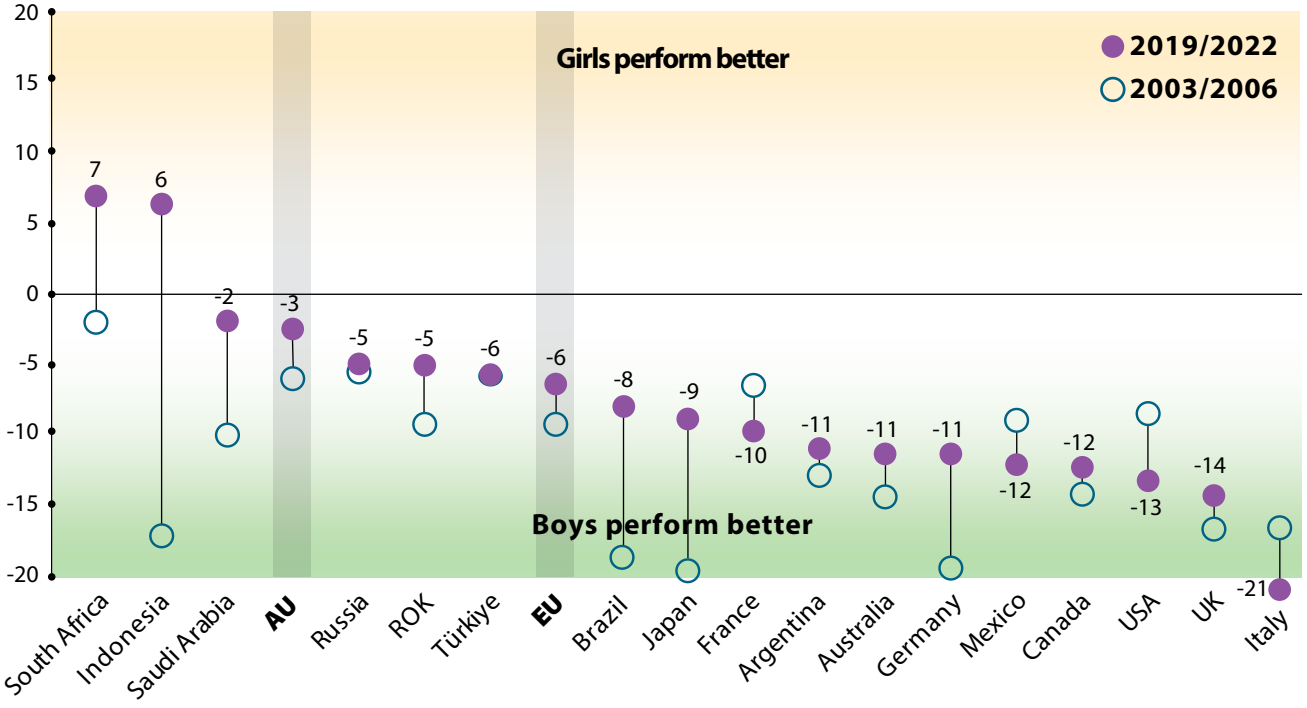
> *The main reasons people provided to discourage me from going into STEM areas were that the time dedicated to continuing research would potentially affect my future life choices such as marriage and having children and the low pay scale even after investing a lot of time in studying.*
>
> Woman, 27, PhD student in biology in India (Gender Scan 2024)

Figure 1.2 Gender gap in science performance scores above grade 4



Sources: PISA 2006 and 2022 and TIMSS 2003 and 2019 (accessed July 2024)[11]

Figure 1.3 Gender gap in mathematics performance scores above grade 4



Source: PISA 2006 and 2022, TIMSS 2003 and 2019, and PASEC 2019 (accessed July 2024)[12]

2. Bridges to girls' STEM education

Gender norms, stereotypes and biases affect girls' STEM aspirations

From an early age, girls are often exposed to societal messages that suggest STEM subjects are more suited to boys, which undermine their pursuit of higher education and careers in these fields.

Girls' confidence in mathematics and science is negatively affected by peers, parents, teachers and school counsellors who hold or even propagate gender stereotypes and bias in STEM. Research has demonstrated that girls who perceive negative stereotypes from teachers and peers regarding their skill level have worse results in mathematics tests[13] and other STEM fields. At the same time, interest in STEM subjects can be positively conveyed through societal relationships. There is thus a need for a systemic approach involving teachers, peers and families to succeed in building interest in STEM from girls, with impact measurements available for decision makers.

Box 1.2

Japan tackles unconscious bias deterring girls from pursuing STEM studies

Japan's Gender Equality Bureau Cabinet Office conducted a study and survey of unconscious bias in 2021 and 2022, informing a series of videos produced to show educators and other adults how unconscious bias deters girls from pursuing STEM studies.

In one scenario, an actor playing a school teacher praises a student for "being good at math, even though you're a girl", making her feel it was abnormal to be a female mathematics whiz. In another, a mother discourages her daughter from pursuing engineering because "the field is male-dominated".

This effort for societal change is complemented by specific efforts to boost girls in STEM. Working with the private sector, the Gender Equality Bureau held more than 100 STEM workshops and events mainly targeting girl students in 2023.

Box 1.3

Argentina's Chicas en Tecnología empowers young women in STEM

Chicas en Tecnología (CET) is an Argentinian non-profit organization aiming to bridge the gender gap in technology by empowering young women through education, mentorship and community engagement with a systemic approach integrating key influencers, such as teachers and families. Operating primarily in Latin America, CET provides programmes that focus on developing skills, confidence and leadership in young women interested in technology involving teachers and parents as well. The programmes are free and open to secondary-level adolescent girls from all over the region, with online and in-person modalities. In 2023, over 1,600 young women participated, generating 156 technological solutions. Of these, 88% expressed a desire to start working in STEM areas and 45% in ICT areas.

> ***People tried to discourage me from going into STEM because of my gender. Many people are surprised that a woman would choose the production industry.***
>
> Girl, 17, engineering student in Brazil (Gender Scan 2024)

> ***I was told at school that IT was not suitable for women.***
>
> Woman, 28, engineering student in China (Gender Scan 2024)

Box 1.4

Training teachers and developing gender-responsive training materials in STEM in Brazil

#EducaSTEM2030, a nationwide movement launched in 2022 in Brazil by UNESCO, promotes girls and women in STEM and equips teachers and school administrators with pedagogical materials that feature inspiring women in STEM, including Indigenous women.

The project developed an online teacher-training in Portuguese that offers a 20-hour self-instructional course on STEM education with a focus on gender equality and transdisciplinary open practices. As a result, 400 secondary school teachers and 500 girls have received specialized training in gender-transformative STEM, and 1,300 municipal education officers have improved awareness about the importance of girls' and women's role in STEM.

Gender representations in educational materials can also perpetuate or ameliorate stereotypes in STEM. Many textbooks and learning resources continue to depict men in dominant roles as scientists and engineers, while women are underrepresented or shown in stereotypical, non-technical roles.[10] This skewed representation reinforces the notion that STEM fields are male-dominated and naturally suited for men, discouraging girls from pursuing these subjects.

STEM activities and play can influence children's views on gender stereotypes by challenging traditional norms and encouraging equal participation. Some G20 countries have launched innovative initiatives to promote gender equity by using playful STEM learning to break down traditional norms, ensuring that both girls and boys have equal opportunities to understand, explore and excel in these areas. For example, as a result of a partnership with the LEGO Foundation and UNICEF, the South African government has adopted play-based learning as a fundamental principle and is developing policies to bring play-based learning into classrooms and pre-school facilities nationwide. Between 2015 and 2021, more than one million South African children were reached through the capacity-building of 150,000 teachers and 100 district officials.

Keeping girls in school enables them to choose STEM

Girls still face significant barriers to their right to education in some countries. Although not a problem exclusive to STEM education, gaps and challenges in school can be particularly challenging to girls' confidence and self-efficacy in STEM subjects, influencing their later educational and career choices.

Girls' disengagement from education is due to many factors, including poverty, child marriage, early pregnancy, discriminatory gender norms in society, child labour, conflict and crisis contexts and the lack of easy and safe access to schools near where they live. These girls need to be given a chance to re-join education systems and have access to accelerated learning opportunities so that they can catch up on their time lost. Digital technologies may play a key role in reconnecting girls to school and in particular STEM disciplines[6] (see Section 3).

Box 1.5

Indonesia partners with the private sector to boost girls in tech

In 2020, Indonesia's Ministry of Communication and Informatics and the Ministry of Education and Culture partnered with YCAB Foundation and the Mastercard Center for Inclusive Growth to train 60,000 girls over the course of 3 years through its *Girls4Tech* digital learning platform. *Girls4Tech* is intended to inspire, within one month, girls aged 10-15 years old to pursue a career in STEM.

Who is teaching, and how they teach, affects how girls engage

Teacher quality, in terms of pedagogical competence and STEM subject technical expertise, combined with curriculum content, plays a crucial role in influencing girls' participation and achievement in STEM.[4] Using engaged learning strategies, such as cognitive-activation (e.g. problem-solving) or hands-on activities like laboratory work, in combination with gender-balanced curricula further engage girls.[14] Specific approaches, including learner-centred, inquiry-based and participatory methods, reduce the gender gap in STEM achievement while benefiting all students. To be effective in reducing the gender gap, teaching practices should cultivate a constructive learning environment that motivates and engages girls fostering girls' self-confidence and caters to their unique interests and learning styles.[15]

> ***The difference of treatment between myself and my male counterparts was awful. Male-dominated classrooms made it intimidating to participate at times. I was made to feel like an outsider in an engineering class in high school.***
>
> Woman, 20, computer sciences student in the USA (Gender Scan 2024)

> ***I was told as a high school intern by farmers that they would never hire a female veterinarian.***
>
> Woman, 31, biology student in South Africa (Gender Scan 2024)

Gender-responsive social and education policies, including those addressing gender-transformative training for teachers and learning contents and materials, can provide a supportive framework for girls to pursue STEM. Although the teaching profession in primary and secondary education is dominated by women, the share of women declines at higher levels of education, particularly in STEM subjects (see Section 2). Seeing and hearing about women in STEM from an early age can foster interest and confidence, broaden perspectives, combat stereotypes and change classroom dynamics, enhance self-efficacy, decrease feelings of isolation, normalise women in STEM and ultimately impact the career choices of girls and boys.

Box 1.6

Türkiye is building enabling environments for girls in STEM

Launched in 2016, the *Engineer Girls of Türkiye* Project is implemented in cooperation between the Ministry of Family and Social Policies, Ministry of Education, Limak Foundation and United Nations Development Programme Türkiye. The initiative aims to empower girls and women studying or planning to study engineering and to increase quality employment for women, adopting a holistic approach in which families, schools and universities work to create an environment conducive to women studying STEM. As of June 2024, over 30,000 students, educators and parents have been trained through a high school programme, and over 110 university students have been trained through a scholarship and mentoring programme. A 'Training of Trainers' focused on gender-based factors that shape girls' selection of professions and gender-based prejudices in the work environment has also reached school counsellors and administrators.

Access to STEM resources, equipment and activities boosts engagement

Providing equitable access to STEM resources, equipment and activities is crucial for boosting engagement among girls in STEM subjects, with such access among the top three drivers of girls' choice to study STEM based on the Gender Scan Survey 2021. **Schools with well-equipped science laboratories, technology kits and access to extracurricular STEM activities see higher participation rates from girls.**[10]

Hands-on learning experiences, such as coding clubs, science fairs and STEM-based competitions, enable girls to develop practical skills and foster a passion for STEM fields. These activities also offer a platform for girls to showcase their talents and build confidence in their abilities. Whether online or in-person, such activities can create meaningful encounters for girls to see what STEM careers may be like for someone with whom they identify.

A growing variety of such options are available in many G20 countries and with regional or even global online options, which may or may not be segregated by gender or target vulnerable groups of girls. To create these experiences, countries are partnering with a growing number of non-profit and civil society initiatives targeting girls and STEM. For example, Canada has invested some USD 11 million since 2019 to promote STEM educational and occupational opportunities to teachers and students up to grade 12 through STEM career profiles and models.[6]

Box 1.7

Australia is funding Indigenous-led STEM support for girls

Aboriginal and Torres Strait Islander peoples have an ongoing relationship with STEM that dates back thousands of years. Yet 0.5% of Indigenous peoples held a university STEM qualification in 2021, compared to 4.9% of the Australian population.

The *Indigenous Girls' STEM Academy* is an AUD $25 million, ten-year national investment in high-achieving Aboriginal and Torres Strait Islander women and girls who aspire to pursue education and careers in STEM professions. From 2018–2028, the Academy will provide activities in three stages, for girls in upper secondary to tertiary education and for teachers. The *Student Initiative* is supporting up to 1,000 Aboriginal and/or Torres Strait Islander young women from upper secondary school, through university and into careers. The *Teachers of STEM Initiative* is supporting the training of up to 99 new, STEM specialized, Aboriginal and/or Torres Strait Islander women teachers.

Indigenous-led steering committees, made up of experts in education, STEM fields and Indigenous research methodologies, advise, guide and monitor implementation. This approach provides a culturally safe and supportive environment for young women to explore their STEM interests and identity, with demonstrated results: among the first cohort of upper secondary students, 73 are considering tertiary pathway options in STEM.[16] This translates to a 95% school retention rate, compared to the national retention rate of 63% for First Nations women students.

Shared experiences broaden perspectives

Visible role models and peers make a difference in girls' career selections. Introducing students to STEM careers through activities within and outside of the classroom is vital for inspiring future scientists, engineers and technologists.

Students answering the 2021 Gender Scan Survey reflected that peers (family and friends) and teachers strongly influenced their choices: in all G20 countries, the largest share of students reported that a relative or teacher was their primary influence on their study choice, followed by access to technology at school (G20 countries and EU) or an event or activity such as visits to a lab or a museum (AU).

> ***Since high school I participated in science competitions. Very few women participated, and I had very few female role models; almost all the coaches were men. I decided to pursue a career that could potentially make me the role model I never had and always needed, as well as someone with the ability to understand and communicate simple and complex scientific knowledge.***
>
> Woman, 19, student in physics in Mexico (Gender Scan 2021)

UNESCO also emphasizes the importance of career guidance programmes that start at the secondary school level.[6] By incorporating presentations from STEM professionals, field trips to companies and STEM career education into the curriculum, teachers can help students understand the diverse opportunities available in these fields.

Furthermore, **mentorship programmes connecting women and girls in school with STEM professionals, including women in STEM careers, can provide invaluable guidance and motivation.** Connecting students with early career and established women professionals can create a positive loop for attraction and retention in STEM. The range of diversities and intersecting factors shaping women's and girls' experiences necessitates an equally diverse range of role models and mentors.

Box 1.8

Two decades of STEM mentoring in Germany illuminates best practices

Launched in 2005, the Germany-wide online-only mentoring programme, *CyberMentor*, enables communication and networking between up to 800 girls (in grades 5–13) and 800 women STEM professionals each year. The *CyberMentor* initiative has given over 9,200 mentoring pairs the opportunity to share their STEM interests and to jointly develop perspectives for the future of their mentees in the STEM field.

The programme increased the mentees' participation in STEM activities and certainty about career plans, regardless of whether one-on-one sessions, group mentoring or a hybrid approach was used.[17] Mentored girls reported stable self-assessed knowledge of STEM topics and confidence in their own STEM abilities – measures that declined significantly among girls who were not in the programme.[18] Further, *CyberMentor* participants were twice as likely to choose STEM majors, compared to girls who had expressed interest in the programme but did not participate.[19]

SECTION 2 Removing barriers for young women advancing to post-secondary STEM education

The transition to post-secondary technical and vocational education and training (TVET)[20] and tertiary education is a critical phase where women and girls either continue or diverge from STEM pathways. The choices they make at this level, influenced by their experiences and the support they receive, significantly shape their future careers in STEM.

These choices impact the overall economy; for instance, an estimated 46% of STEM-related occupations in Europe by 2025 will require medium-level qualifications which are primarily acquired through TVET, and STEM professionals in the EU earn on average 19% more than other groups.[21]

Gender parity or, more commonly, overrepresentation of women in enrolment in higher education overall has been reached in almost all G20 countries, and parity is maintained among graduates.[22] The one exception is sub-Saharan Africa where parity has not been achieved.[6] Yet around the world, women remain underrepresented in STEM fields, particularly in disciplines such as engineering and technology.[22] By understanding the challenges and opportunities women face in TVET and tertiary education in STEM, we can better support their journey, laying a strong foundation for their participation in the STEM workforce and leadership.

1. Recent trends

Fewer women than men choose and complete STEM degrees

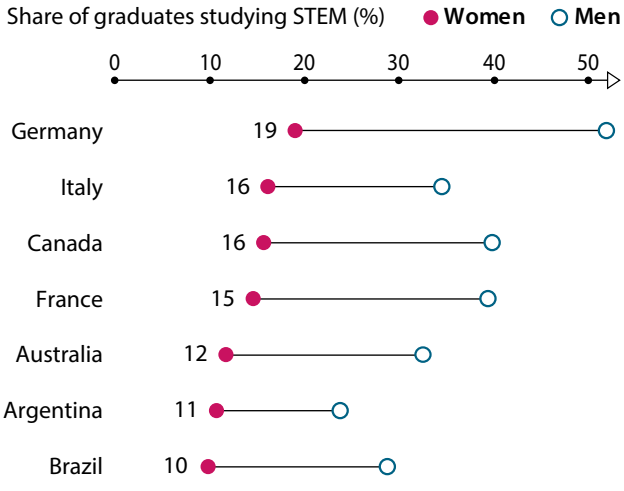
Globally, the share of women who study and graduate in STEM fields has not changed in the past 10 years.[23]

A larger share of men is still choosing STEM subjects in the seven G20 countries with available data (Figure 2.1). The share of women graduates of tertiary education who graduated in STEM fields ranges between 10% in Brazil and 19% in Germany, compared to 29% and 52% of men.

If we look at the percentage of women and men graduating in STEM disciplines, overall, women formed 35% of all STEM graduates in the 18 G20 countries with available data (see Figure 2.3), and no G20 country achieved numerical parity[24] with the exceptions of South Africa (where women accounted for 47% of STEM graduates) and India (45%) (Figure 2.2).[6]

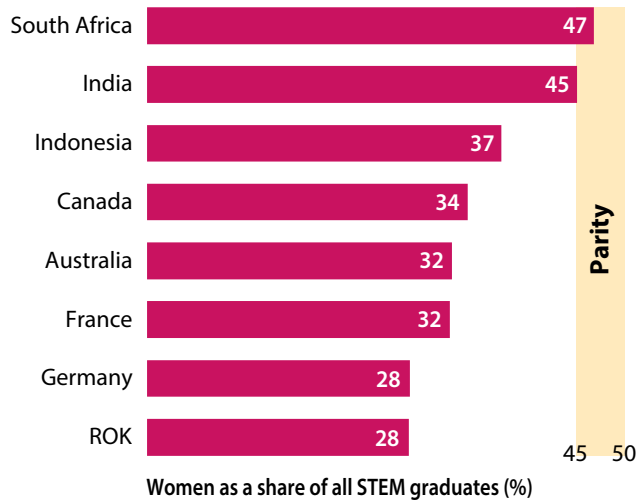
Figure 2.1

Share of women STEM graduates among women tertiary graduates and of men STEM graduates among men tertiary graduates



Source: UNESCO Institute for Statistics, June 2024. Data from 2021 except for Brazil (2020)[25]

Figure 2.2 **Share of women graduates among STEM tertiary graduates**



Source: UNESCO Institute for Statistics.2022 or most recent data. Reproduced from UNESCO, Global Education Monitoring Report: Gender report – Technology on her terms (2024).

Furthermore, the share of women is lower at graduation than at enrolment in STEM fields. Although there is no global dataset, studies in several countries have indicated that more women transition away from STEM courses or leave their studies. For instance, in a 2022 study of four-year STEM programmes in the USA, men persisted at higher rates (65%) than women (48%).[26] In Germany, women students had a 23% higher dropout rate than their men counterparts.[27] **The gender gap thus worsens in the final stages of study, at the time when students would be preparing to enter the workforce.**

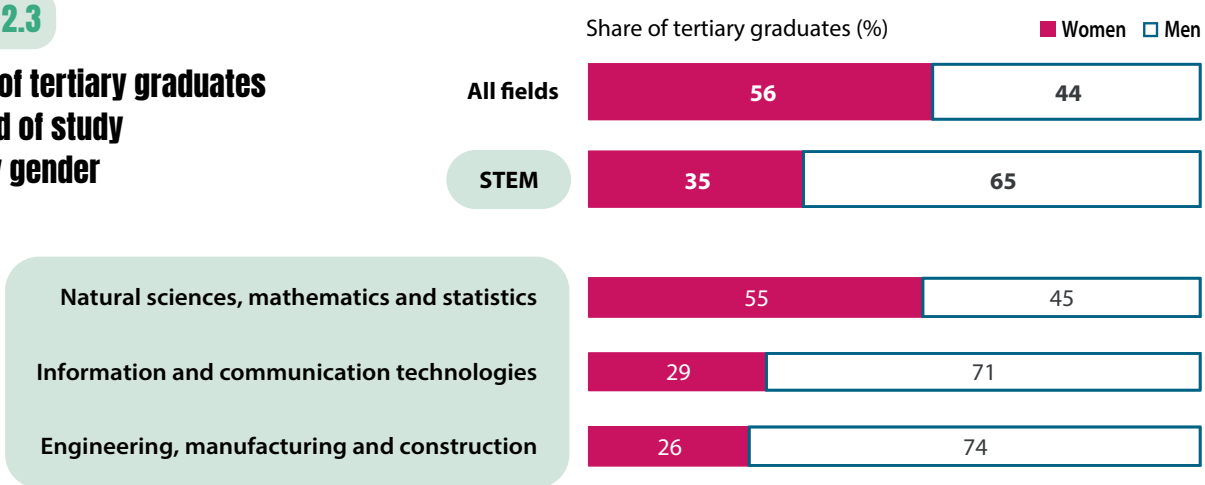
Within STEM, certain disciplines attract more women

Even within STEM fields, substantial gender disparities persist, and **women are more likely to choose certain disciplines than others**. In the 18 G20 countries with available data, engineering, manufacturing and construction as well as information and communication technologies (ICT) are heavily male-dominated fields, with men composing 74% and 71% of graduates, respectively (Figure 2.3).

In terms of trends, the representation of women has very slightly increased since 2015 in these conventionally male-dominated fields, from 23% to 26% in engineering, manufacturing and construction and from 28% to 29% in ICT.

Figure 2.3

Share of tertiary graduates by field of study and by gender



Source: OECD, UNESCO Institute for Statistics, Eurostat (2023) in OECD (2023) Education at a Glance. Data for 2021 or most recent year[28]

STEM programmes provide opportunities for a more sustainable economy, social welfare and inclusion, productive development and for improvements in terms of governance and institutions. ICT sectors, in particular, have been generating many jobs and are expected to grow more in the coming years, with the 4th industrial revolution underway, catalysed by the COVID-19 pandemic and the widespread accelerated need for digitalization.[29] ICT, alongside engineering, mathematics and some science specializations, offer highly paid jobs primarily in stable contracts, starting at early-career level.[30] However, the proportion of women in G20 countries is higher in courses related to healthcare, teaching, social work or personal services – sectors which often provide low salaries and precarious working conditions and which are under a greater risk of automation.[31]

Women remain outnumbered among faculty, impacting student experiences

The share of women teachers at tertiary level exceeds 35% for the 11 G20 countries with data and has reached parity in four of them.[32] However, **women teachers are underrepresented among STEM teaching positions and in leadership roles**, particularly within higher education.[21] In addition to improving the experience during STEM studies, the representation of women among faculty may transform representation among graduates: according to data from the Society of Women Engineers in the USA, a 1% increase in the number of women among faculty could lead to almost a 0.5% increase in the number of degrees awarded to women in engineering.[33]

Women teaching STEM have a positive influence on girls' and women's performance and pursuit of STEM studies and careers.[3,34] Employing women as teachers has been linked to better educational experiences and improved learning outcomes for girls across various subjects and contexts.[35] Women teachers can positively influence girls' education in STEM by dispelling myths about sex-based, innate abilities and by acting as role models for girls. [15,36]

Gender imbalance and lack of diversity among faculty and students reinforces stereotypes that STEM fields are inherently male domains, and the underrepresentation of women in STEM fields may push women and girls to feel they must prove their competence and legitimacy.

Box 2.1

Limited data suggest greater bias in STEM TVET

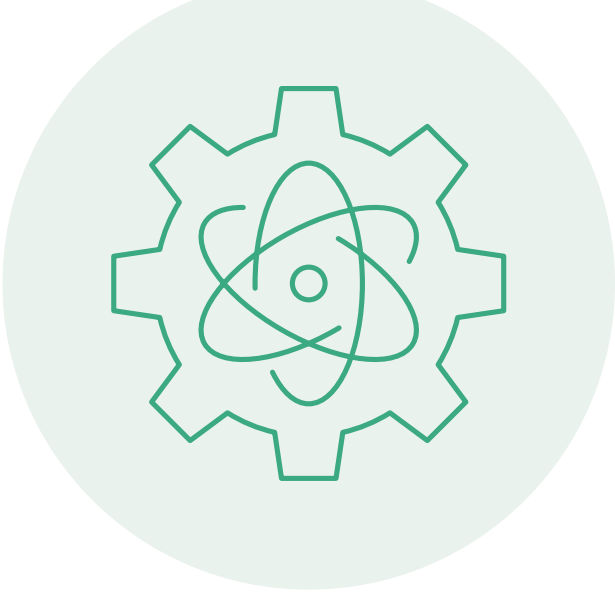
There is growing interest in the participation of girls and women in STEM-related TVET. The OECD reports that the proportion of women among short-term secondary vocational students in STEM grew from 14% in 2013 to 20% in 2021 in G20 countries.[80] Regarding short-cycle tertiary vocational education, a 2020 UNESCO report provides an overview of the findings of a first scoping study on the availability of data and information on gender disparities in STEM-related TVET for ten countries,[81] including three G20 countries (Australia, Germany and South Africa).[21]

UNESCO's research highlights that women are underrepresented in STEM-related TVET, in some cases more so than for STEM-related programmes in other types of education.[21] For example, in Australia, women make up 37% of enrolments in university STEM courses but just 17% of TVET STEM enrolments.[82]

The consequences in terms of careers are severe, particularly combined with a 'leaky pipeline' in which women's representation drops between school and the workforce. In Australia, only 15% of the STEM-qualified jobs are held by women – and women form just 3% of the TVET-level STEM-qualified workforce.[82]

In order to truly grasp the possibilities for improvement and impact of initiatives taking place on the personal, institutional and/or societal level, more research is needed into their effects on the participation and performance of girls and women in STEM-related TVET.

2. Catalysts for women studying STEM



Key challenges and barriers impacting women participation and performance in TVET and tertiary education share many similarities to those experienced in primary and secondary education and are in addition highly influenced by the recruitment process, the institutional environment and gender relations.

Policy and institutional approaches can boost women's entry into STEM courses

Gender-responsive and gender-transformative policies and support systems targeting or developed within academic, research and training institutions can **boost women's access into STEM programmes, leading to flow-on positive effects from greater diversity.** Creating gender quotas or providing gender-responsive training to address the biases of selection processes and committees can shift patterns in initial acceptance or placement, although still dependent on women wishing to apply. Scholarships and funded learning exchanges can also provide financial incentives for women in STEM fields. In addition, support systems for balancing education and family responsibilities are particularly important for women students at an age when many are expected to hold caring responsibilities and start families of their own.

> ***I would like for the tech field to have more equal representation. Where I live, tech is dominated by white men with the financial means and cultural capital to succeed in a system built by and for people like them.***
>
> Man, 40, student in computer science in the USA (Gender Scan 2024)

For instance, in Japan, as of early 2024, at least 40 universities have implemented a quota system for women applicants in fields related to STEM – fields where women represent less than a third of all students, dropping to 15% for engineering at the undergraduate level.[37] Some 700 places across these universities have been set aside for women applicants in the 2024 entrance examinations.[38] The introduction of these quotas is a response to the Ministry of Education, Culture, Sports, Science and Technology (MEXT) enrolment selection implementation guidelines for 2023, in which a section on "the inclusion of those with a diverse background" put special emphasis on women in STEM fields.

Box 2.2

Nurturing emerging scholars with an intersectional lens in South Africa

South Africa's *Nurturing Emerging Scholars Programme* (NESP) has set a recruitment target of 55% Black women. Since the programme was launched in 2020, universities have been awarded 104 NESP scholarships for enrolment of candidates to two-year master's degrees linked to an academic internship in their third year. Further along the pipeline, the country's *New Generation of Academics Programme* has a transformation intake goal of 55% women, giving them access to a three-year development programme (to acquire a PhD) and a further three years in a tenured academic position.[39]

> ***A greater diversity of entry routes to engineering schools, and a greater parity and diversity of students and professors should be promoted.***
>
> Woman, 21, student in geosciences in France (Gender Scan 2024)

Box 2.3

India's Scholarship Programmes for Women in Engineering and Technology

India has made significant strides in promoting gender equality in STEM education through targeted scholarship programmes aimed at supporting women pursuing engineering and technology studies. One notable programme is the *Pragati Scholarship Scheme* launched in 2014 by the All India Council for Technical Education (AICTE). This initiative specifically targets women pursuing technical education, providing financial assistance to cover tuition fees and other educational expenses. The scheme is designed to support the education of up to two girls per family and is open to students enrolled in diploma and degree programmes in AICTE-approved institutions. In 2020, the number of scholarships granted annually was more than doubled from 4,000 to 10,000. This programme not only alleviates the financial burden on families but also encourages more women to enter and complete STEM education.

...but retention to complete their training also matters

Having examined the pathways that lead young women and men to pursue STEM courses as they begin higher education, it is crucial to understand how these trajectories shape their experiences once they enter these programmes. Many of the above-discussed challenges young women face in early education, such as **gender bias and stereotypes, differential encouragement by parents, peers and teachers, gendered roles, expectations and environments, and structural inequalities**, continue to impact them along their educational pathways. These pre-existing issues often translate into difficulties in integration, increased stress levels and a sense of isolation for many women as students.

However, it is equally important to highlight the **positive experiences reported by women in STEM programmes.** These include the satisfaction derived from mastering complex subjects, developing useful skills and having interesting career prospects, the support from mentors and peers and the growing sense of belonging as they navigate their academic journeys. Emphasizing these positive aspects is essential to attract more girls into STEM fields, demonstrating that, despite the challenges, the rewards and opportunities for personal and professional growth are substantial (Box 2.4).

> ***I was drawn by basic curiosity on the topic and the opportunity to be able to impact human lives with my work.***
>
> Woman, 27, biology, biochemistry student in India (Gender Scan 2024)

Globally, universities and higher education institutions are more focused on measuring women's access to higher education (about four in five universities track gender in application rates) than tracking their outcomes and success rates (less than two-thirds of them track women's graduation rates and have plans aimed at closing the gap).[40] Information about performance and the factors pushing women away from STEM choices is essential to better inform policy responses.

Box 2.4

Insights from the experience of STEM students

Respondents from G20 countries to Gender Scan's Survey in 2021 shared insights into their perceptions and experiences studying STEM.

Both men and women expressed high levels of contentment with their academic choices in STEM fields, with over 60% responding 'yes, absolutely' and another 30% 'yes, rather' when asked if they were satisfied with their choice of study.

Feeling useful to society is a significant factor contributing to the satisfaction of STEM students in higher education, particularly among women. The **development of new competences and skills** was the most satisfying aspect for STEM students, positively perceived by 9 out of 10 students regardless of gender. Opportunities to work in diversified sectors (87% of women and 82% of men), the intrinsic interest of the studies (87% of women and 77% of men) and the ease of finding a job after graduation (86% of women and 87% of men) were also key satisfaction factors.

Overall, **men were slightly more likely than women to report feeling fulfilled** (85% of women and 86% of men), **comfortable** (83% of women and 89% of men), **settled in** (82% of women and 89% of men) **and supported** (72% of women and 75% of men) in STEM fields. The feeling of being in a competitive environment was more prevalent among women, as approximately half of the women responding (43%) felt this sentiment, in contrast to 28% of men. The lack of gender balance was also identified as a major challenge by 35% of women and 31% of men studying STEM.

Another factor of dissatisfaction present in higher rates among women than among men is the feeling of not having the necessary level to succeed. Such fears, part of 'imposter syndrome', were reported by 58% of women studying STEM, climbing up from 39% of men declaring the same feeling.

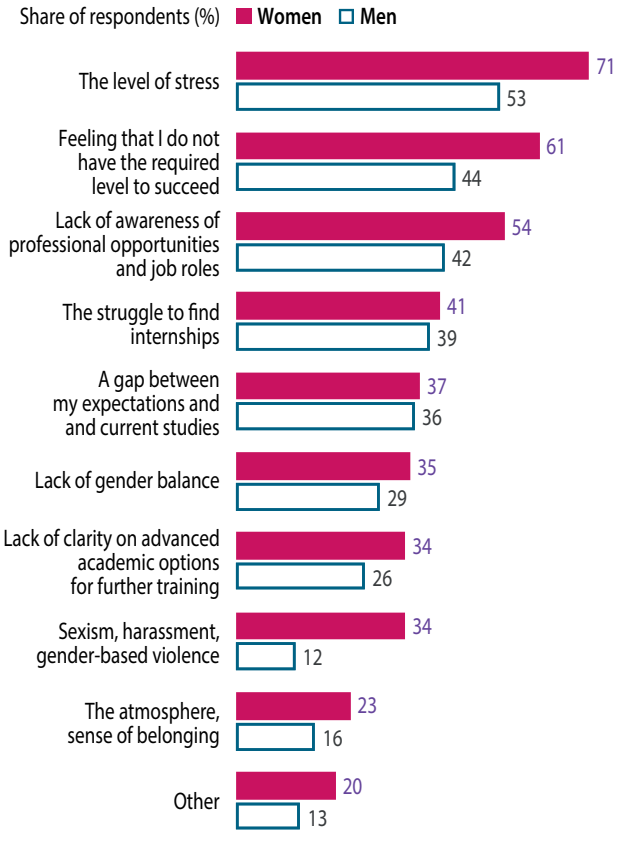
Even more serious, **over 40% of women studying STEM reported having been the target of sexist behaviour**. Men accorded less impact to sexism, with 7% or fewer of men considering sexism to be stressful, disheartening or leading to lower self-esteem. By comparison, 36% of women reported sexism as a top challenge in their STEM studies.

Both men and women placed high importance on academic support and the quality of instruction. Effective teaching practices, availability of faculty for mentorship and supportive academic advising are critical components that enhance students' learning experiences and satisfaction. However, **women students prioritized the availability of supportive mentorship** more highly.

Programmes that highlight the versatility of STEM degrees and provide **exposure to diverse career paths** tended to enhance satisfaction among women students. The ability to transition between various sectors – such as academia, industry and government – and roles within the STEM field was seen as a major advantage and may help in mitigating the gender gap in STEM career retention.

Figure 2.4

Top challenges faced by STEM students, by gender



Source: Gender Scan Student Survey 2021[41]

Box 2.5

African consortium awards provide specific measures to retain women in STEM fields

Between 2011 and 2021, the Consortium for Advanced Research Training in Africa (CARTA), based in Nairobi, Kenya, sponsored 228 doctoral and postdoctoral fellows, 57% of whom were women, across a number of countries.

CARTA uses several practical measures to attract and retain women. Within their merit-based admission procedure, the application defines a different cut-off age for men and women recognizing that women often complete their graduate studies later in life. Once in the programme, PhD fellows are entitled to paid maternity and paternity leave and are granted a leave of absence during their maternity leave. CARTA also assists with childcare costs for mothers of young children, and overall, equal financial support is provided to all fellows regardless of their gender.

These measures attempt to offset the unique barriers faced by women as they pursue careers in STEM. Efforts are paying off. In the reporting period of 2017 and 2018, women fellows raised 40.4% of the USD 3.7 million in research funds sourced by the fellows.[42] Among the first cohorts, more men (74%) had graduated than women (58%), but there was no difference in on-time graduation rate. However, nearly twice as many men (440) as women (282) authored scientific publications during their fellowship.[42]

> ***Supervisors, professors and advisors have to be given anti-harassment training.***
>
> Woman, 31, PhD student in natural sciences in South Africa (Gender Scan 2024)

Women are not immune to negative gendered beliefs and roles

Results from the Gender Scan Survey (Box 2.4) confirm that **the imposter syndrome**, a psychological pattern where individuals doubt their accomplishments and fear being exposed as frauds, **is predominantly experienced by women**. Women doubt their abilities more and are less likely to seek help. In fact, gaining help may be seen as undermining their efforts to prove their worth: in a perverse loop, a woman enduring difficulty would supposedly build the resilience women need to survive and thrive in their careers, navigating the expected ongoing hostility. While men students can also feel unprepared, they are typically more confident in seeking support and resources due to fewer stereotypes questioning their competence and their entitlement to be in STEM environments.

Gendered environments, such as science laboratories and industrial workshops, can exacerbate imposter syndrome in women, often due to male-dominated imagery especially in safety signage.[43] Reluctance to ask for help may lead to unique safety risks related to physical differences or perceived inadequacies, such as smaller stature or reduced strength. It is essential to **design laboratory equipment and workspaces ergonomically to accommodate the physical diversity of all users**, including differences in height, strength and reach. Additionally, implementing safety protocols that consider the specific needs of women, such as providing protective gear in a range of sizes and using gender-sensitive signage, can alleviate these issues.

In addition, sexism, harassment and gender-based violence, both online and offline, create hostile environments that deter women from pursuing and remaining in STEM studies and careers. **Academic performance is negatively affected by sexism and gender-based violence** as a consequence of the stress and the decrease in self-confidence that these experiences create.[44] Experiences with sexism have been linked to lower intentions to major in STEM, lower STEM self-efficacy and lower STEM grades.[45, 46]

Box 2.6

A charter promoting an inclusive environment for women in STEM in UK, Ireland and Australia

The *Athena Scientific Women's Academic Network (SWAN) Charter*, initially established in the United Kingdom of Great Britain and Northern Ireland in 2005 and later adopted in Ireland and Australia in 2015, provides a framework for supporting and transforming gender equality across higher education and research. Institutions that sign up to the charter are required to develop action plans to promote gender equality and foster an inclusive environment for women in STEM, including staff and students. Positive impacts perceived by both women and men included structural and cultural changes, including enhanced support for women's careers, increased appreciation of caring responsibilities, and efforts to combat discrimination and bias.[47] In addition, implementation of new mentoring schemes, career development seminars and annual personal development reviews were also cited, on top of policies such as core hours for meetings and improved maternity leave arrangements.[47]

Access to resources and to STEM industry networks can bridge the gap to careers

Mentorship and awareness programmes that connect women students with successful women in STEM can inspire and guide them through their educational and career pathways.

Box 2.7

Teamwork strengthens women and girls in STEM in the Republic of Korea

The STEM *Research Team Programme* connects women graduate students as research leaders managing a team with middle/high school and college/university students to conduct research projects for several months. This programme, led by the Korea Foundation for Women in Science, Engineering and Technology (WISET), aims to strengthen the research competence and leadership skills of excellent undergraduate and graduate students while helping middle and high school students to plan and develop their career paths. From 2013 to 2023, over 7,600 participants were served by 150 teams in eight research fields, with 89% of the girls participating as high school students going on to enrol in a science or engineering university.

WISET was established in response to the Republic of Korea's 2002 Act on Fostering and Supporting Women Scientists and Technicians. It aims to increase the number of women in STEM through targeted interventions, such as scholarships, internships and mentorship programmes as well as awareness campaigns to challenge gender stereotypes and promote the benefits of STEM careers for women. WISET also oversees the regular, state-approved Survey on the Employment and Working Conditions of Women in STEM.

> ***Systems of mentoring and support for the development of professional networks that respond to the needs of women should be further supported.***
>
> Woman, 26, PhD student in biology in Argentina (Gender Scan 2024)

Women often face **challenges in accessing necessary resources, such as funding, modern equipment and industry connections**, which are crucial for practical learning and skill development as well as to facilitate access to the labour market.[3,21,48] The difficulty in visualizing clear career paths and finding internships can be particularly discouraging for women students who struggle to see how their education translates into career opportunities. Collaborations between educational institutions and industries can improve job readiness for women students. The context of industry partnerships is often more suited to masculine modes of interaction in existing informal or formal networks, such as after-hours events which may exclude women who have responsibilities as carers. Industry partners may also need training and support in ensuring readiness for women candidates, from practical considerations such as protective equipment designed for women's bodies to cultural considerations such as mechanisms to mitigate gender-based harassment in the workplace.

Germany's dual vocational training system integrates classroom instruction with on-the-job training, providing students with practical experience in their chosen fields. This system has been particularly effective in promoting women's participation in technical fields by offering structured mentorship and clear career pathways, particularly useful given that women in STEM possessed less labour market experience compared to men STEM students and their women counterparts in non-STEM.[27] Gender-specific scholarships and initiatives aimed at encouraging girls to enter non-traditional trades have also contributed to higher enrolment rates in STEM-related TVET programmes.

Improving access to funding is crucial for retention. For instance, 88% of undergraduate scholarship recipients from the USA-based Society of Women Engineers are either still pursuing or have earned a STEM degree.[49] This retention rate is notably higher compared to the overall rate, where less than half of women persist in their bachelor's degree programmes in STEM.[49]

Given the range of challenges and pressures faced by women undertaking STEM studies, more comprehensive policies deploying measures across this range are needed. For policies and attempts towards cultural transformation to be effective, men and women must all engage to create more accessible and enjoyable STEM education.

Box 2.8

The University of Guadalajara in Mexico includes men in a comprehensive approach

The University of Guadalajara has established a Promotion Committee for Gender Equality and Office for Gender Equality, created a Unit for Equality in 2021 to coordinate related policies and programmes, built the Centre for Gender Studies to focus on research and teaching on gender issues and implemented the UNESCO Chairs in Gender, Leadership and Equity and in Equality and Non-Discrimination. These structures introduced policies and frameworks, such as an ethics code emphasizing equality and non-discrimination, a strategy against gender-based violence with protocols for reporting and support as well as disaggregated data to address gender gaps, and incorporated gender equality into the university's development plan, including curriculum content and governance representation.

Related programmes and activities have been promoted, including gender sensitization conferences and workshops reaching thousands of participants, and a compulsory gender equality course for new staff and students was launched in 2021. A particularly innovative activity is the *Men's Circle*. Promoted by UN Women, it offers training and spaces for male students to discuss masculinity and the roles men can play in the promotion of gender equity.

An important success factor was initial support from a federal government programme, which helped prioritize gender equality at the strategic level and kickstart activities later consolidated and sustained by the university's own resources.

SECTION 3

Making work in STEM possible and worthwhile for women

According to UNESCO's *Call to Action to Close the Gender Gap in Science* (2024), achieving gender parity in STEM careers is not only a matter of social justice but also an economic imperative. Diverse teams bring a wider range of perspectives and ideas, which is essential for scientific and technological advancements. Further, increasing women's participation in STEM fields can help address labour shortages in critical sectors and contribute to gender equality in the workforce.

Equitable representation in STEM thus leads to more inclusive and resilient societies, capable of addressing complex issues with effective solutions.

This section delves into the trends, challenges and opportunities for women as they begin and advance in their STEM careers, highlighting policy interventions from G20 countries that support women's career progression and access to leadership positions in these fields.

1. Recent trends

Women remain underrepresented in STEM occupations and careers

All available data confirm that women remain under-represented in the STEM workforce in G20 countries, the EU and the AU.

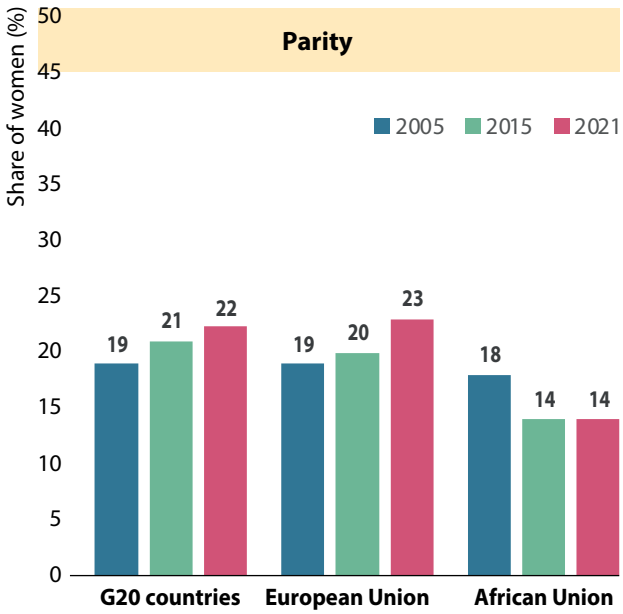
There are two-fold fewer women in STEM occupations than in the overall workforce, with no significant improvement in balance over the past decades in G20 countries.[50] Women formed 42% of the workforce in 2021 but held only 22% of STEM occupations, almost unchanged from 19% in 2005.

The proportion of women among STEM professionals has increased in the G20 countries and the EU by four percentage points since 2005, but the reverse has occurred in the AU. Parity has not been reached in any region (Figure 3.1).

Women also account for a minority of the world's researchers: approximately one in three researchers are women, whether working in government, higher education, private, non-profit or other unspecified sectors.[51] **Numerical gender parity among researchers, within the range 45% to 55%, has been reached in only three G20 countries**, namely Argentina, Brazil and South Africa (Figure 3.2).

Figure 3.1

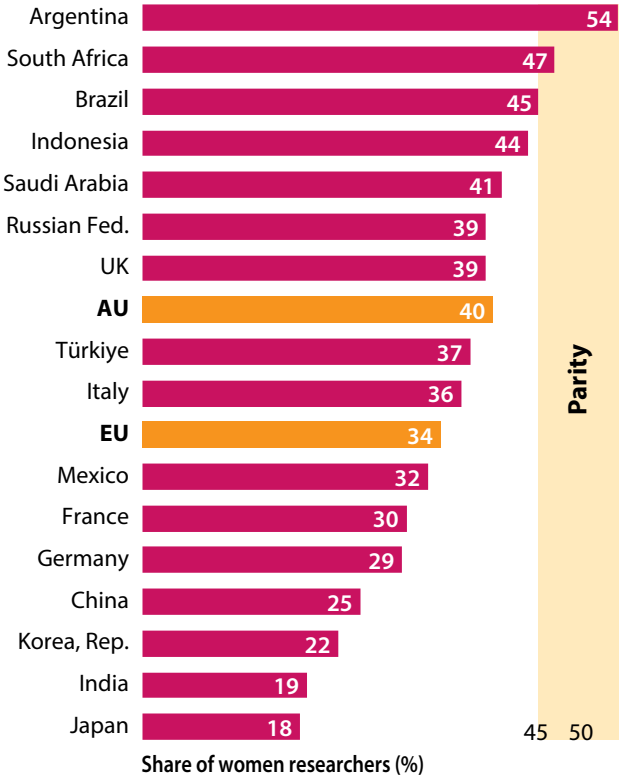
Share of women in STEM occupations



Source: ILOSTAT, accessed July 2024. Data from 47 countries in 2005, 102 in 2015 and 101 in 2021[52]

Figure 3.2

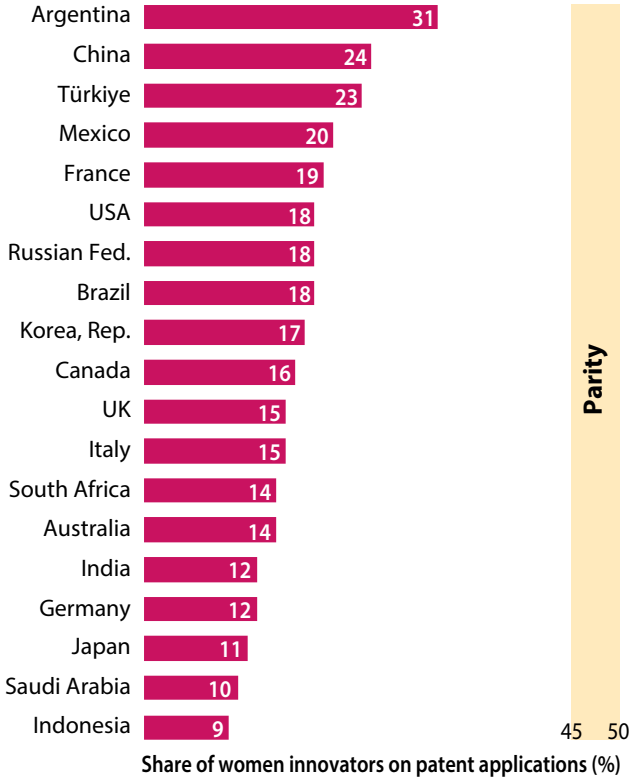
Share of women researchers



Source: UNESCO Institute for Statistics, January 2024. Data from 2021 or most recent year are not available for all countries[53]

Figure 3.3

Share of women inventors



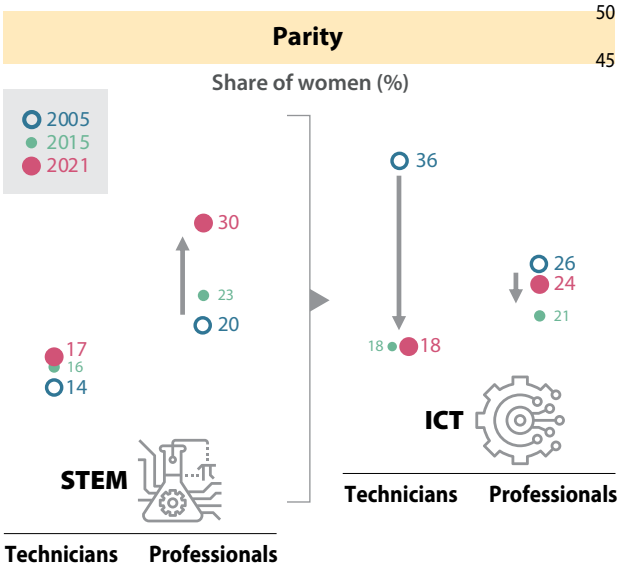
Source: WIPO, accessed July 2024. Data from 2023 [55]

Women inventors were involved in 23% of all international patent applications between 1999 and 2020, while men were involved in 96%.[54] In 2023, women constituted 17.7% of all inventors listed in published Patent Cooperation Treaty (PCT) applications, globally, and were more prevalent in academia (21%) than in the private sector (14%). Among the G20 countries, women accounted for 20% or more of inventors in only Argentina (31%), China (24%), Türkiye (23%) and Mexico (20%).

With regard to the representation of women in the various STEM occupations and functions, over the past two decades for the G20 countries, **the proportion of women has diminished among ICT professionals and technicians** but remained stable or grew in science and engineering overall (Figure 3.4). Women represent fewer than one in three STEM professionals.

Figure 3.4

Share of women among technicians and professionals in STEM and in the subset ICTs



Source: ILOSTAT, accessed July 2024. Data from 2005, 2015 and 2021[56]

The glass ceiling for women in STEM remains unbroken

Leadership roles in STEM are more likely to be held by men: for instance, only 29% of the leaders of national science academies globally are women, albeit a larger share than the 16% of members of these academies.[57] Meanwhile, 10% of Nobel Prizes in natural sciences have been awarded to women since 2011. According to LinkedIn data, the 'drop to the top' from entry-level to C-suite positions is more pronounced in STEM occupations: **women make up a quarter of non-STEM leaders but one-tenth in STEM**.[48]

Women are also underrepresented in school management, senior faculty, university leadership and education policymaking positions, with impacts on the experiences, attraction and retention of women STEM students (see Section 2).

Although data are not available for G20 countries, global and regional trends are illuminating. For example, in 2022, just 21% of the top 200 universities globally in the Times Higher Education World University Rankings have a woman as leader.[58] Across Africa, the average percentage of senior academics who are women across all participating universities is 36%.

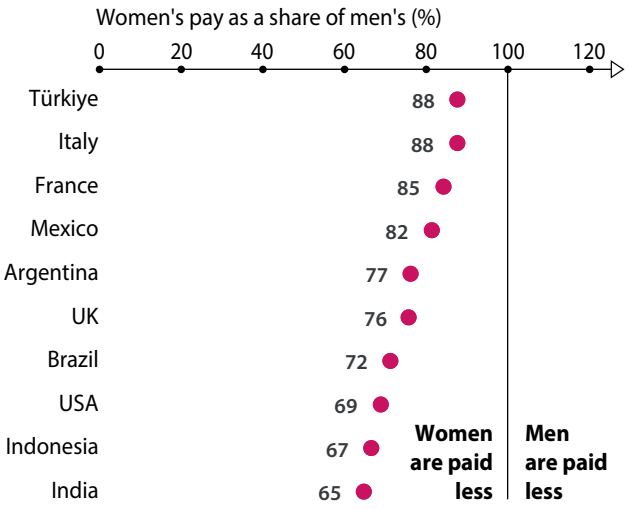
Despite the impact and value of the work of women STEM professionals, they remain underrepresented in decision-making roles and less visible to the next generation of potential STEM professionals, and this imbalance can shape career aspirations and environments.

Women are out-earned by men in STEM fields

For the 10 G20 countries with data on the earnings in STEM occupations, **women's pay was less than 85% of men's pay in eight countries** (Figure 3.5).

Figure 3.5

Women's pay as a share of men's in STEM occupations



Source: ILOSTAT, accessed July 2024, average monthly earnings of STEM employees in 2021 purchasing power parity (PPP $). Data from 2023 or most recent year[59]

Disaggregated wage data for STEM fields remain rare, but the general trends provide valuable insights. In Australia, the gap between women's and men's pay in STEM industries was 16% in 2023.[82] In the United States, on average, tertiary faculty salaries for women were 83% of those for men in 2023/24, a slight improvement from 81% in 2009/10.[60] These differences persist despite a growing number of countries adopting national policies or legislation for equal pay, with 87% of countries in Europe and 57% in Sub-Saharan Africa having such laws.[48]

Research grants are a key financial resource for many working in STEM. **Women are less likely to obtain research grants** than men, and when they do, they receive smaller amounts on average.[3] According to the publisher Elsevier,[61] the average share of women among grant awardees increased from 29% in 2009 to 37% in 2022, based on data for 13 countries, including ten G20 countries.[62] As with other leadership roles, **representation among funding decision makers remains uneven** (Box 3.8).

2. Enablers to strengthen diverse and inclusive STEM workforces

Women face systemic barriers in STEM functions that limit their career advancements, including lack of flexible work organization, adequate career management as well as enabling parental and caregiving support policies. In addition, outright gender bias and discrimination prevent them from developing their careers and accessing leadership positions. Although the number of women pursuing careers in STEM is gradually rising in G20 countries, albeit slowly, their absence is still notable among researchers, faculty, STEM industry professionals and leaders, in particular in the ICT fields. Even more concerning, women are pursuing STEM training but then exiting the field.

Implementing workplace diversity and inclusion policy frameworks can shape experiences within the workplace as well as career progression, counterbalancing gendered limitations on opportunities for advancement and retention. National policies provide crucial frameworks for measures and processes at institutions and industry levels. Implementation of such policies has direct impacts on retention, particularly for policies relating to bias given that employees who witness or experience discrimination, bias or disrespect are nearly 1.4 times more likely to quit their job.[63]

> ***There needs to be a leadership pipeline program which explicitly has an aim of improving the gender disparity in managerial levels. Ensure that there is diversity in hiring process and encourage teams that have wide gender disparity to seriously think of recruiting women at all levels.***
>
> Woman, more than 45 years old, engineer/manager in UK (Gender Scan 2024)

Box 3.1

Insights from the experience of STEM professionals

Respondents from G20 countries to Gender Scan's Survey in 2021 shared insights into their perceptions and experiences working in STEM sectors and occupations.

Results indicate that there is a **significant gender gap among STEM workers in terms of satisfaction with career management**, with fewer women (51%) satisfied compared to men (61%). Similarly, for parental support, a lower percentage of women (64%) were satisfied compared to men (79%). Both genders reported almost equal satisfaction (88% of women, 89% of men) with their working arrangements, including schedule flexibility. These findings indicate that while flexible work arrangements are well-received across the board, targeted improvements are needed in career management and parental support to address gender-specific concerns and promote gender equality in the workplace in STEM fields.

When it comes to retention, top motives for women and men willing to quit their STEM jobs were limited professional development prospects (61% of women, 59% of men), while **perceived penalization for the use of parental support systems had the largest gender gap** (mentioned by 28% of women and 13% of men) (Figure 3.6).

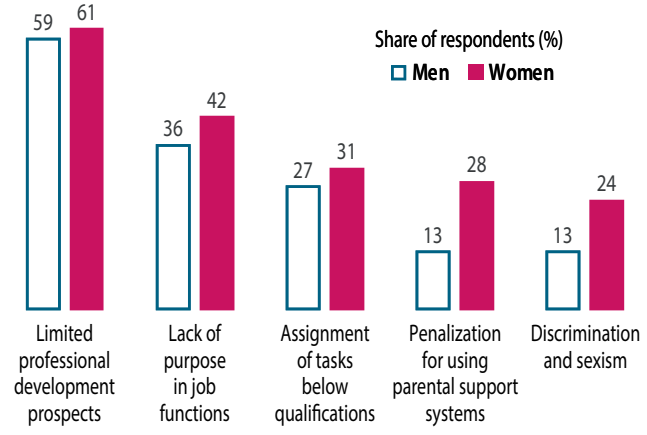
When asked about the factors that contribute to job satisfaction, supportive management and well-defined objectives registered a significant gender gap (78% of women and 87% of men for the first, 79% of women compared to 87% of men for the latter). Flexible scheduling ranked third (83% women, 85% men), behind recognition from colleagues (86% of women, 91% of men) (Figure 3.7).

In addition, **significant gender disparities persist in perceptions of workplace gender equality** in G20 countries. There is a notable gap in perceptions of wage equality: 73% of men believed wages are equal between men and women, compared to only 45% of women. Similarly, there is a disparity in views on promotion opportunities, with 78% of men believing equal opportunities exist versus 52% of women.

Men may be less aware of the challenges women face, often taking for granted the unequal access to information and networking opportunities, bias and structural inequalities that favour men, leading to better performance evaluations, higher pay raises and more frequent promotions.

Figure 3.6

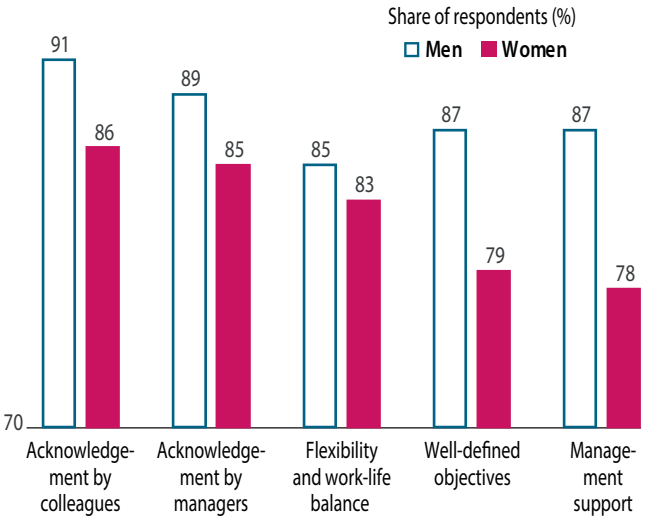
Top motives for dissatisfaction of STEM workers, by gender



Source: Gender Scan Employees Survey 2021.[64]

Figure 3.7

Top motives for satisfaction of STEM workers, by gender



Source: Gender Scan Employees Survey 2021[64]

Unbiased hiring and equal roles open opportunities for women in STEM

The organization of work and career management mechanisms define whether there is a place for women. The nature of jobs within STEM organizations plays a pivotal role in determining the inclusivity of these fields for women, ensuring that roles available align with their professional aspirations and personal needs.

But first, women must appear as candidates. Employers that are seeking greater diversity in their workforce report difficulties sourcing candidates of diversified groups, as in the case of Canadian tech companies.[65] Many factors can either render women candidates in STEM fields, particularly ICT fields, invisible or push them away, including reliance on inhospitable recruitment and networking events, algorithmic biases in job dissemination and talent acquisition software, as well as limited referral networks. **Adopting more equitable candidate sourcing techniques and diversifying sources** can help to increase gender diversity in the candidate pool in G20 countries, in particular in the tech industry.[65] Given the existing biases in advanced technologies and software, policy intervention may be necessary to reshape such tools or guide their usage in professional contexts, with specific efforts to reach out to vulnerable and minority groups of women (Box 3.2, Box 1.7).

Employers could also accommodate unconventional resumés, as women are more likely than men to interrupt their careers to fulfil childcare responsibilities: 47% of UK women in STEM had career interruptions compared to 17% of men based on a 2022 survey by STEM Returners. Backed by UK government funding in 2023,[66] STEM Returners partners with STEM organizations to run short-term paid returner schemes as well as providing career coaching, upskilling and mentorship opportunities.

> ***Companies and institutions should provide additional resources and incentives to increase the number of women in leadership positions and to further develop young talents in that direction.***
>
> Woman, more than 45 years old, engineer/manager in Germany (Gender Scan 2024)

Promoting flexible work structures, career management and organizational processes are other crucial steps towards mitigating gender biases that hinder women's progression in the workplaces. Within a job, tasks should be assigned based on the individual's skills and strengths, not their gender. For instance, even once hired by a STEM institution or sector, women may face more calls to do 'people-focused work' than 'research work'. Supporting managers to remove or compensate for their unconscious gender bias can contribute to more enabling working environments. In addition, career progression support including training, active promotion of gender balance in all career stages, standardized performance reviews and the inclusion of gender equality expertise in promotion committees can ensure both men and women have opportunities to advance and counteract systemic discrimination.

Box 3.2

Canada challenges businesses to achieve gender parity

Canada's STEM workforce benefits from nationwide policies and frameworks that support gender diversity as well as collective action. The *50 – 30 Challenge*, co-created by the Government of Canada, civil society and the private sector in 2020, aims to attain gender parity (50%) and significant representation (at least 30%) of underrepresented groups on boards and senior management positions in order to build a more diverse, inclusive and vibrant economic future. This initiative has gained widespread support with over 2,500 participating organizations in July 2024, among which over 100 used 'tech' in their business name. One major result is the *What Works Toolkit* of online resources offering support in policy development; approaches for recruitment, mentorship and promotion; employee and board member retention; anti-racism; anti-harassment; and inclusive workplace strategies.

Bridging the digital gender divide and investing in inclusive tech and digital sectors

Women and girls are often prevented or discouraged from using ICTs or the Internet, impacting their competencies and future professional development in digital and tech disciplines. Women are currently underrepresented in the tech sector, including ICT occupations and in artificial intelligence (AI) development: they represent just 28% of the tech industry workforce worldwide and only 20% of the leadership positions.[6] The percentage of women working in AI today is approximately 30%, roughly 4 percentage points higher than it was in 2016.[67]

Not only are women missing out on job opportunities in a rapidly growing industry, but their absence also means that the needs and perspectives of women and girls are likely to be overlooked in the design of products and services that impact our daily lives. Women must be an active part of developing the digital economy to eliminate gender biases and stereotypes perpetuated through digital platforms, software and programmes, including those generated using AI. AI systems reflect the values of their creators and developers, known to carry their own significant cognitive biases into the design and operation of AI systems. Overall, 44% of AI systems demonstrate gender bias.[68]

Several G20 countries are taking action. During its G20 presidency, India launched the TechEquity platform to empower women with digital literacy skills. Indonesia (Box 1.5) has a variety of programmes promoting digital literacy and women's leadership, such as inclusive digital transformation programmes and digital talent scholarships.

In Brazil, the initiative {*reprograma*}, awarded with the UNESCO Prize for Girls' and Women's Education in 2021, provides training to thousands of under-represented and low-income women and girls in coding and other in-demand digital skills. 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.

The 2021 UNESCO's *Recommendation on the Ethics of Artificial Intelligence* guides a growing number of partners around the world to empower women and girls in this sector. The UNESCO's *Women4Ethical AI Platform*, launched in March 2023, supports governments and companies' efforts to ensure that women are represented equally in both the design and deployment of AI.

Box 3.3

Saudia Arabia invests in empowering women in tech around the world

The Saudi Authority for Data and Artificial Intelligence partnered with American tech firm Google in 2022 to launch a global programme, called *Elevate*, addressing the gender gap in the technological sector, especially artificial intelligence (AI). *Elevate* aims to use AI to reduce the gender gap by empowering more than 25,000 women globally in the next five years. The programme will provide free accessible training to women in tech and science, empowering them and pursuing the growing number of job opportunities in the field of data and AI. The programme has two tracks, with 30% of trainees following the technical track for Data Engineer, Cloud Architect, ML Engineer and Data Scientist and 70% of trainees on a non-technical track for Cloud Business Enthusiast. In its first phase, 1,000 women representing 28 countries participated.

Box 3.4

Connecting women in high-tech fields in Russia

The professional community *Women in Nuclear Russia* formed in 2016 as a response to the needs of women experts in this sector – and quickly growing to reach the broader tech industry, launched in 2022 a survey which revealed that 70% of women at technical universities in Russia felt difficulties in building a career in science and technology. In response, the association created an international mentoring programme for women students of technical universities in Russia and abroad. *Women in Nuclear Russia* has hosted over ten in-person, distance and hybrid events on *Women in Tech* since 2021. The mentoring sessions have been attended by more than 250 women studying at technical universities in Russia and other countries. This effort is in line with Russia's *National Action Strategy for Women for 2023–2030*, which identifies increasing women's participation in high-tech industries and popularizing engineering and technical professions among girls and women as an important focus for enhancing the role of women in socio-economic development.

Inclusive workplace considerations make STEM possible for women

Women often need to balance career aspirations with gendered family responsibilities, such as caring for children and elderly family members. Careers in STEM can become less linear for women due to these responsibilities, making **supportive career environments and gender-responsive work arrangements** essential. Policies and measures that facilitate career re-entry and diverse job opportunities within STEM can help accommodate life events and family duties, thus minimizing the impact and length of career disruptions.[69] The ability to transition across different sectors and roles within STEM can also provide a more adaptable career trajectory, although attention must be directed to ensuring stable, longer-term contracts are equally available to men and women.[70] In addition, flexible work options, such as adjustable working hours and remote work opportunities, are particularly valued and demanded by employees to support work life balance.

> ***I would like to see improved flexibility in terms of both working methods and working time as well as more support to caregivers.***
>
> Woman, 31 to 45 years old, technician in Italy (Gender Scan 2024)

Proactive parental and caregiving support policies also play a crucial role in promoting gender equality by addressing the disproportionate burden of childcare and domestic responsibilities often placed on women. Policies such as paid parental leave and affordable childcare are critical in enabling both men and women to balance professional and personal responsibilities in STEM and all fields and to reduce the risk of attrition and career interruptions among caregivers.

> ***Setting up a company childcare centre or providing reserved places in external centres would enable a better balance between work and personal time, and would relieve the mental burden, for the most part borne by women, of having to keep to working hours versus nursery hours.***
>
> Woman, 31 to 45 years old, manager/ engineer in France (Gender Scan 2024)

Connecting women in STEM and improving the visibility of women as STEM experts also plays a vital role in supporting women's participation and advancement. Mentorship and networking programmes, in particular, offer guidance and support, helping women navigate their careers, build professional networks and overcome barriers to leadership positions.

Box 3.5

Italy involves women and men to combat inequalities in academia

In Italy, the University of Naples Federico II Gender Observatory on University and Research developed a mentoring scheme in 2018 to combat the practices and mechanisms that foster gender inequalities in academia. The model takes a dual approach to mentoring, simultaneously working to support women's careers and create institutional change. To strengthen the transformative capacity of mentoring, the second edition also included men, both as mentees and mentors.

Box 3.6

The USA invests in research and practice to promote equity among STEM faculty

The goal of the US National Science Foundation's (NSF) *ADVANCE* programme is to increase the representation and advancement of women in academic science and engineering careers, broadening the implementation of evidence-based systemic change strategies that promote equity for STEM faculty in academic workplaces and the academic profession. The NSF has invested over USD 270 million since 2001 to support *ADVANCE* projects at more than 100 institutions of higher education and STEM-related not-for-profit organizations.

Since 2018, the *ADVANCE Resource and Coordination* (ARC) Network collates resources and convenes actors to inform and create equitable STEM workplaces across sectors. Through its *Virtual Visiting Scholars* programme, researchers conduct meta-analysis, synthesis and big data curation on topics crucial to STEM faculty equity and offer new insights and applications. The *Emerging Research Workshops* engage leading investigators in intensive workshops on innovative and emerging research on faculty equity in STEM.

Fair pay and STEM funding need a gender-based rehaul

To bolster women's participation and retention in STEM fields, **ensuring they have fair and equal pay as well as equal access and equitable assessment for funding opportunities** such as grants and fellowships is crucial. Financial incentives specifically designed for women can significantly enhance their access to career advancement in these fields and counter existing biases.

> ***Equal pay and more investment in career guidance could make the difference for women in STEM.***
>
> Woman, 31 to 45 years old, engineer in India (Gender Scan 2024)

For instance, the L'Oréal-UNESCO For Women in Science programme has rewarded outstanding women researchers for 25 years, in recognition of the contributions of their research, the strength of their commitments and their impact on society. The programme has benefited 127 International Laureates, 330 International Rising Talents and more than 4,000 young women researchers, half of them in developing countries. It provides not only financial support but also recognition, which can be pivotal in advancing their careers and extending their reach as role models, as well as awareness of their fields of study. It also raises awareness of the challenges faced by women in science and promotes policies and initiatives to address these challenges.

Proof of its success is that six L'Oréal-UNESCO laureates have subsequently received the Nobel Prize in their field of expertise, the latest two in 2023 when Professor Anne L'Huillier (France), 2011 laureate, was awarded the Nobel Prize in Physics, and Professor Katalin Karikó (Hungary/USA), 2022 laureate, was awarded the Nobel Prize in Physiology or Medicine.

National programmes like India's *Women in Science and Engineering-KIRAN* (WISE-KIRAN) scheme provide targeted financial assistance and grants to support women scientists in their research endeavours. The scheme also provides training and other support, including efforts to develop a *Charter for Gender Equity in STEM* to bring about transformational changes at Institutional level. To date, 30 Indian institutions have participated in a pilot exercise. Moreover, initiatives like the African Union's African *Women in Science and Engineering Awards* celebrate and financially reward the achievements of women scientists, promoting their contributions and encouraging more women to pursue STEM careers.

Box 3.7

China is guiding support and funding for women in science and technology

Through a blend of framework documents and practical steps, support is growing for women in scientific fields in China. In 2021, the Ministry of Science and Technology (MOST), the China Association for Science and Technology (CAST) and eleven other departments jointly issued the "Notice on Several Measures to Support Women in Science and Technology Talent to Play a Greater Role in Scientific and Technological Innovation." In the same year, the All-China Women's Federation, the MOST, the CAST and four other departments released "Opinions on Implementing the Women's Action Plan for Scientific and Technological Innovation." Multiple measures have been taken since, focusing in particular in improving access to funding for initiatives supporting women's STEM professionals. For instance, in 2023, the CAST launched a call for applications with a total funding of 2.6 million RMB for projects aimed at supporting STEM women professionals, including S&T innovation workshops, communication campaigns and mapping surveys of women scientist organizations.

Box 3.8

Science granting councils in Africa are developing gender policies

Awards of a higher monetary value were more likely to be awarded to men by science granting councils (SGCs) in Sub-Saharan Africa, according to a 2022 study of 15 such SGCs.[71] Although the SGCs have achieved near parity in the number of grants given to men and women, practical and policy-supported change are needed to address imbalances in value and in SGC staffing (36% women). In 2017, none of the SGCs had policies or frameworks to mainstream gender into their science, technology and innovation (STI) initiatives. Several councils have since developed gender policies.

Councils in Côte d'Ivoire, Kenya, Mozambique, Malawi and Senegal have implemented activities to support women in the steps preceding grant funding, such as gender-specific funding instruments supporting women training at master's and doctoral levels. Malawi's SGC supported an association of women scientists, while Ethiopia's SGC focuses on capacity building and financial support for women scientists in universities. Some SGCs also recognize women's research excellence through prestigious awards and offer workshops in grant proposal writing. These efforts are complemented by initiatives like mentoring early career scientists and identifying senior women scientists as role models.

> ***It is crucial to secure the same conditions (salary, title corresponding to the work function) independent of gender and to promote women to "real" leadership position and not only to filling a percentage of seats on committees.***
>
> Woman, over 45, engineer in Saudi Arabia (Gender Scan 2024)

Head counting is not enough

Monitoring the participation, performance and perspectives of girls and women in STEM, by collecting sex- and gender-disaggregated data on a regular basis at national level is crucial to build an evidence base for decision-making. Some G20 countries have made significant efforts in this direction. For instance, launched in 2020 and aiming to publish annually for ten years, Australia's *STEM Equity Monitor* is a national data resource on women's and girls' participation in STEM which collects and reports data on gender equity across various stages of education and employment in STEM fields. The *STEM Equity Monitor* covers critical indicators such as attitudes towards STEM, school performance in mathematics and science, higher education enrolment and completion, workforce participation and gender pay gaps in STEM industries.

Regular and strategic assessment underpins policy and the path towards equitable STEM. Yet simply counting people by role, such as those who do research at least a part of their professional time, does not convey the full situation for women and girls in STEM. Numerical parity is used as a proxy indicator for the larger socio-cultural context in which women STEM professionals operate.

There are even risks of feminization of a field or of countertrends: for example, despite a slight increase in the percentage of women as members of the Mathematical Society of Japan, the percentage of women in awards and invited lectures significantly decreased between 2004 and 2019.[72]

Among organizations participating in the Global Research Council, 82% collected gender-disaggregated data for funding applications and 77% recorded the gender of the principal investigator of a funded project, with regional differences, based on a 2019 survey. However, only 15% and 9% of the 65 surveyed organisations respectively collect data on the integration of sex and gender considerations in the process of research production (research design and methods) and in the process of research uptake (dissemination and use of research), with Europe as a leading region in this regard.

A blend of **qualitative and quantitative assessment, with mechanisms to hear from those directly involved in STEM work** as it evolves in societal contexts is indispensable to better contextualize trends in girls' and women's participation. Such data are needed for all stages of STEM.

Gender-based violence has no place in STEM

Gender-based violence,[73] in its physical, sexual and psychological forms, continues to surge around the world at alarming levels, affecting school as well as workplace participation, well-being and performance. It is a particular problem in STEM (Box 3.9). Based on international surveys, **84% of women researchers reported having been victims of sexism at least once[74] and 49% of women scientists say they have experienced sexual harassment at work.**[75] In a 2022 survey in Europe, two out of three women working in universities and other research organizations had experienced gender-based violence.[45] According to a 2018 study in the USA, academics in STEM endure the highest rate of sexual harassment of any profession outside the military.[76]

Gender-based violence, including technology-facilitated gender-based violence, further exacerbates the challenges faced by girls and women in STEM fields. Experiences of sexism, harassment and gender-based violence, both online and offline, create hostile environments that could deter girls and women from pursuing and remaining in STEM studies and careers.

> ***What discouraged me was mostly witnessing sexism and harassment in technical spaces.***
>
> Woman, 31, engineering student in Canada (Gender Scan 2024)

Box 3.9

Insights from STEM professionals on gender-based violence

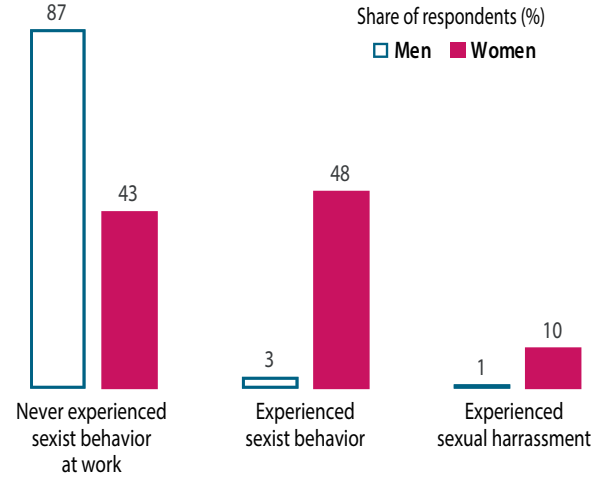
Results from the Gender Scan Survey 2021 confirmed that women are significantly more likely to be victims of sexism and gender-based violence than men in STEM sectors.

Women STEM workers from G20 countries reported experiencing sexist behaviours at a proportion more than ten times that of men (48% compared to 3%), highlighting the widespread nature of everyday sexism that women face in the workplace. A majority of men (87%) reported not experiencing any sexist behaviours at work, compared to 43% of the women. 10% of women respondents declared having been victims of sexual harassment in the workplace compared to only 1% of men.

Preliminary results from the ongoing Gender Scan 2024 survey suggest that despite a slight improvement in the five G20 countries with initial data – as the proportion of women professionals reporting experiences of sexist behaviours decreases to 37% and the proportion of those indicating that they have never experienced any sexist behaviours grows to 44%[77] – gender-based violence in STEM workplaces remains a crucial problem that needs to be addressed to attract and retain women in STEM.

Figure 3.8

Experience of sexism and harassment, by gender



Source: Gender Scan Employees Survey 2021.[78]

The impact of sexism and harassment is, at least, twofold, touching individual well-being and one's relationship with their workplace and career. Exposure to sexist and harassing behaviours can lead to emotional exhaustion from the continuous need to defend one's competence and deal with hostile behaviours. The stress and trauma associated with these behaviours can severely affect well-being, reducing productivity and job satisfaction, undermining women's confidence and self-efficacy as well as increasing absenteeism and the likelihood of women leaving their jobs or the STEM field altogether. Thus, **sexism and gender-based violence perpetuate gender inequalities in the workplace and discourage women from pursuing careers and leadership roles.**

> ***As a woman in a STEM field, I have become accustomed to off-hand jokes or comments that make me feel belittled, uncomfortable, or judged by my gender. I think a lot of women just want to be valued for the quality of their work, so they shrug off the comments that hurt because they don't want to be viewed as the woman that overreacted about "just a joke" in the workplace. I want to be successful at my job, so I have tended toward masking my feelings and saying nothing.***
>
> Woman, under 30, technician in the USA (Gender Scan 2024)

There is even a risk of a 'backlash' effect: women in gender-balanced STEM courses experienced gender-based violence more frequently than their peers in men-dominated STEM courses or in any non-STEM courses, based on research in the USA.[46] The problem was compounded for ethnic minorities.

Intersecting factors, such as age and ethnic identity, create particular challenges for women researchers. Among women aged 18–24 years old, 64% reported sexist remarks as the biggest problem with which women in research are confronted; this share declined with age yet one in four women aged 45–59 years still agreed.[74] Moreover, women researchers working on specific areas, such as COVID-19 or climate change, were more likely to face harassment or threats based on personal characteristics (up to ten times more likely than men). This highlights the importance of implementing holistic policies and measures addressing the range of challenges and opportunities and following an intersectional approach, with mechanisms to monitor impacts and unintended consequences.

Policies and procedures to prevent, mitigate and respond effectively to incidences of sexism, gender-based violence and harassment can be decisive to attract and retain women and girls in STEM. **Strong zero tolerance policies and measures to gender-based violence** as well as programmes promoting training on unconscious gender bias and discrimination in STEM workplaces are essential to foster a more inclusive, diverse and safer environment. Creating awareness and educating employees about these issues and implementing reporting and support procedures and instruments for victims and witnesses of misconduct can help build a supportive culture and environment where women feel valued and respected.

> ***I didn't feel safe to use my institution's reporting system because I had no information on the process and potential outcomes and for fear of retaliation.***
>
> Woman, 31 to 45 years old, engineer in Brazil (Gender Scan 2024)

Box 3.10

France uses private sector partnerships and legislation to combat sexism

Some G20 countries have implemented legislative measures and supported institutional mechanisms to prevent and fight sexism. France, for instance, incorporated the notion of "sexist acts" in the Labour Code in 2015, inspiring the launch of the initiative *#StOpE au Sexisme Ordinaire en Entreprise* by Accor, EY and L'Oréal France in 2018, which supports all employers who commit to fight sexism in their organizations. In 5 years, this initiative has gathered 270 signatories, representing a total of 4.4 million employees. This type of corporate initiative can notably contribute to supporting women who experience sexist behaviours or sexual harassment yet who fear lack of support or backlash when reporting these issues.

THE PATH FORWARD

Securing STEM futures for girls and women is part of a larger effort to promote diversity, inclusion, equity and accessibility in our societies.

This policy brief aims to contribute to the understanding of the persistent gender inequalities in fields related to science, technology, engineering and mathematics (STEM). Structural inequalities and societal norms and values that have an impact on the full participation of women and girls in STEM exist across all the stages of STEM, from pre-education through to advanced careers. These inequalities persist despite equal or greater performance of women and girls in foundational skills and career productivity.

The gender gap can be narrowed by supporting equal participation and leadership in STEM through **targeted policies, measures and initiatives addressing each stage of STEM**. This includes dismantling gender stereotypes, creating open educational pathways for girls in STEM and removing obstacles and building supportive environments that attract, retain and advance women to thrive in STEM studies and careers. These efforts must be **backed up with the collection of gender-disaggregated data** on a regular basis at country level to devise evidence-based policies and monitor progress.

Despite the growing demand for cross-nationally comparable statistics on gender in STEM fields, data and their use in policymaking remain limited. For example, at university level, data are available regarding enrolment in STEM studies by gender but not performance or experiences. At the career level, reporting on the share of women and the experiences of women in STEM jobs, from experts to innovation project managers and researchers, is limited.[79]

Monitoring mechanisms used in G20 countries to track gender equality in STEM include, among others, Australia's annual *STEM Equity Monitor,* the Republic of Korea's *Survey on the Employment and Working Conditions of Women in STEM*, the USA's biennial *Diversity and STEM* reports, the European Union's *She Figures* report released every three years and the continued participation in monitoring of educational systems and women researchers supported by the UNESCO Institute for Statistics, which constitute a key evidence base for policies in this area. An equivalent effort would be needed in the STEM-related private sector to assess women's contribution to innovation and growth. These efforts need to be continued and developed further to inform effective policies and measures.

Hearing directly from women and girls is an important avenue to strengthen the evidence base for decision-making. Qualitative and quantitative survey-based methods can illuminate opportunities to attract, retain and empower women and girls in STEM based on their personal experiences and inform policy solutions to promote gender equality in STEM.

Policy interventions are crucial to dismantle structural inequalities, remove obstacles, gender stereotypes and biases within STEM fields and broader society and leverage opportunities to stimulate and reward interest in STEM. Policy is a key driver of education, workplace and institutional realities, with practical considerations central to fighting the observed attrition of girls' and women's participation in STEM. At this stage, **it is insufficient for STEM to be interesting. STEM must also be possible in practice and worthwhile** by comparison to other fields that are welcoming to high-performing women and girls.

A growing range of actions could be used, engaging parents and primary caregivers as well as teachers, academic, research and training institutions, industries and leaders, ensuring that boys and men are also engaged in ending misconceptions and biases against girls and women in STEM. Again, it is crucial to listen to and meaningfully involve women and girls, particularly through professional and civil society organizations in the field of STEM as well as youth and women's rights organizations, in the design, implementation and monitoring of these actions intended for them. In combination with rigorous evaluations of the impact of interventions, these systemic approaches can succeed in boosting girls' and women's equal involvement in STEM studies and STEM jobs.

Growing gender equality in STEM in the G20 : Areas of action

Supporting and contributing to the implementation of international efforts, including the UNESCO 2024 *Call to Action: Closing the Gender Gap in Science,* the UNESCO 2024 *Call to Action on the Freedom and Safety of Scientists* and the UNESCO 2022 *Call to Action: Advancing Gender Equality and Girls' and Women's Empowerment in and through Education*, can accelerate gender equality in STEM. Within this global framework, action must be prioritized in the following areas to change the game and reverse the lack of significant progress over the past two decades:

- **Dismantling gender stereotypes and biases in STEM** to counter harmful gendered practices in and expectations about STEM fields, and raising awareness of the importance of the equal participation of women and girls in STEM education and workforces.
- **Enhancing visibility and recognition for women and girls in STEM** and for the contributions of women to STEM to raise public interest, to change mentalities and to showcase role models for future generations.
- **Strengthening gender-transformative STEM education** at all levels with attention to curriculum design, representation of women in teaching roles and in educational materials, inclusive equipment and the quality of teacher training and support and counselling systems, along with community/parental engagement.
- **Creating mentorship and industry-partnered programmes and opportunities** for girls and women to connect with women as role models and mentors in STEM and to access industry and professional networks.
- **Ensuring fair and equal pay as well as developing financing and investments** for girls and women in STEM.
- **Fostering inclusivity within STEM funding mechanisms**, including by promoting women's access to key decision-making and management positions, including on relevant boards and panels.
- **Enacting gender-transformative policies and measures** to promote equality and diversity in the STEM community, including targeted measures such as mandated gender equality training, quotas and numerical targets to help address systemic barriers to girls and women.
- **Building transparency and accountability** within STEM workplaces and educational institutions regarding staff and student diversity, support systems and family planning, salary structures, contracts and financial allocations, among others.
- **Implementing zero tolerance policies and measures to gender-based violence**, including sexism and sexual harassment, as well as corporate social responsibility initiatives supporting women and girls in STEM workplaces.
- **Monitoring the participation, performance and perspectives of girls and women in STEM** education and careers, to build an evidence base for decision-making by collecting sex- and gender-disaggregated data on a regular basis at national level.

UNESCO Calls to Action to address gender inequalities in STEM: a holistic approach

Launched on the occasion of the International Day of Girls and Women in Science, the 2024 *Call to Action to Close the Gender Gap in Science* integrates contributions from a multitude of stakeholders, including international organizations, government institutions, non-governmental organizations and academia as well as from the private sector, which form the basis for key actionable recommendations to tackle the root causes of the gender gap by:

- Dismantling gender stereotypes and biases in science;
- Opening educational pathways for girls in science; and
- Creating workplace environments that attract, retain and advance women scientists.

Under the International Decade of Sciences for Sustainable Development (2024–2033), UNESCO supports and monitors progress in the implementation of this Call to Action.

In addition, UNESCO's 2022 *Call to Action: Advancing Gender Equality and Girls' and Women's Empowerment in and through Education* identifies leverage points for a range of stakeholders to advance gender equality and girls' and women's empowerment in and through education.

The 2024 *Call to Action on the Freedom and Safety of Scientists* recognizes the specific safety and health challenges and vulnerabilities faced by women in science.

UNESCO'S GLOBAL PRIORITY GENDER EQUALITY FRAMEWORK

STRATEGIC OBJECTIVES

Reduce inequalities and promote learning and creative societies in the digital age through quality education for all

Work towards sustainable societies by preserving the environment through the promotion of science, technology and the natural heritage

GENDER EQUALITY FOCUS

ACHIEVE GENDER EQUALITY IN AND THROUGH EDUCATION

EMPOWER WOMEN IN SCIENCE AND TECHNOLOGY FOR ENVIRONMENTAL ACTION

AREAS OF WORK

ACCESS | **CURRICULUM & PEDAGOGIES** | **STEM**

- Access to equitable and gender-responsive education and learning, including in science, technology, engineering and mathematics (STEM) is widened
- Laws, policies & strategies for gender equality in and through education developed and implemented
- Gender-responsive teaching, content and learning opportunities are increased
- Gender gap in learning achievements and completion rates reduced

▶ ***Contributing to SDG Targets 4.1, 4.3, 4.5, 4.7***

SCIENTIFIC LEADERSHIP | **ECOSYSTEMS & BIODIVERSITY** | **WATER & OCEANS**

- Women's careers in decision-making positions advanced and role models promoted
- Gender transformative science, technology and innovation (STI) policies and Open Science policies enhanced
- Women's and girls' resilience and action for sustainable management of natural resources reinforced
- Gender responsive water and ocean's management and governance promoted

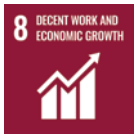
▶ ***Contributing to SDG Target 5.5***

CROSS CUTTING THEME

WOMEN PEACE AND SECURITY:

ACTIONS

- Awareness raised through advocacy campaigns and public debates
- Capacities and skills strengthened
- National laws, policies and strategies elaboration and revision supported



Build inclusive, just and peaceful societies by promoting freedom of expression, cultural diversity, education for global citizenship, and protecting the heritage

PROMOTE INCLUSION AND COMBAT GENDER-BASED VIOLENCE

DISCRIMINATION & STEREOTYPES | **FREEDOM OF EXPRESSION & CREATION** | **DECENT WORK & SOCIAL PROTECTION**

- Gender-based threats, violence, discrimination and stereotypes tackled, including in the digital environment
- Learners and learning environments equipped to be safe and healthy
- Women's working conditions, employment opportunities and economic, cultural and social rights improved
- Gender equality promoted in and through the media and cultural sectors

▶ ***Contributing to SDG Targets 4.2a, 5.1, 5.2, 5.6, 8.5, 8.8, 16.10***

Foster a technological environment in the service of humankind through the development and dissemination of knowledge and skills and the development of ethical standards

BRIDGE THE DIGITAL GENDER DIVIDE

ETHICAL STANDARDS FOR AI & DIGITAL PLATFORMS | **MEDIA & INFORMATION LITERACY** | **DIGITAL SKILLS & COMPETENCIES**

- Ethical standards addressing gender bias in digital technologies and artificial intelligence (AI) systems developed and implemented
- Equitable and gender responsive access to and use of information and knowledge fostered in the digital environment
- Women and girls empowered with digital skills and competencies
- Women's leadership in AI and the digital environment supported

▶ ***Contributing to SDG Target 5.b***

CRISIS PREPAREDNESS AND EMERGENCY RESPONSE

- Information, knowledge and data collected, analysed and shared
- Technical assistance and policy advice provided
- Partnerships and networks established, strengthened and fostered

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Gender Scan

Conducted biennially since 2016, Gender Scan Survey examines factors influencing gender equality, such as discouragement from STEM studies, harassment, barriers to leadership, pay gaps, and supportive workplace policies. It also captures perceptions of how gender affects university and workplace dynamics. Gender Scan identifies levers to promote the equal participation of women in STEM through its own global surveys and public sources providing benchmarks and aggregates for a comprehensive overview.

CHANGING THE EQUATION

Securing STEM futures for women

Diversity in science, technology, engineering and mathematics (STEM) fields benefits the global community, permitting the expression of the human right to science and supporting the achievement of global goals.

Yet women and girls remain less likely than boys and men to advance to the next stage of their education or career in STEM, despite strong performance. To close the gender gap, STEM studies and careers must be made not only possible but also worthwhile, as a competitive choice for girls and women.

Based on trends in education through to careers, this policy brief identifies mechanisms to improve girls' and women's aspiration, participation, retention and performance in STEM fields. Examples of good practices from G20 countries illustrate ways to create lasting change.

This brief is part of UNESCO's contribution to the G20 Working Group on Women's Empowerment and is the result of an intersectoral cooperation initiated by UNESCO's Division for Gender Equality with the UNESCO's Education and the Sciences Sectors.

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