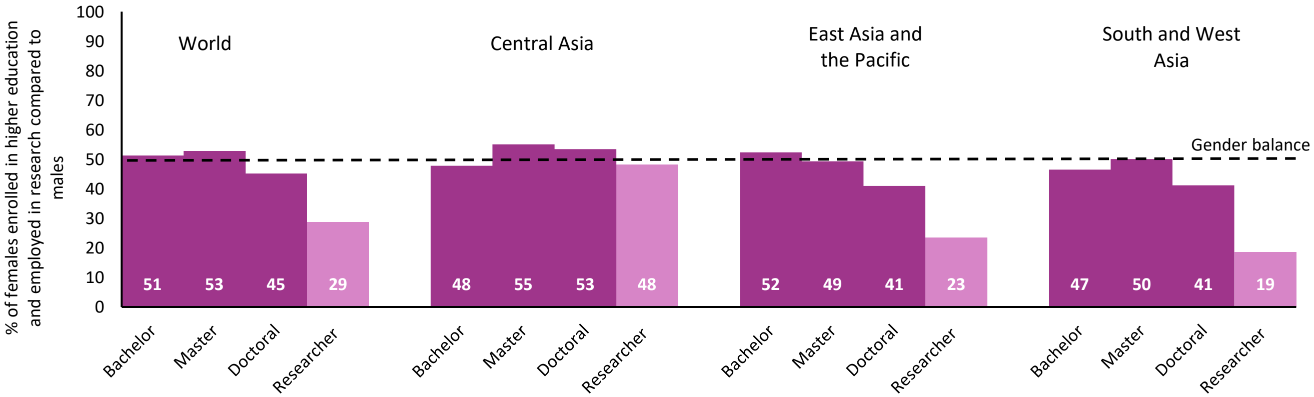
The International Day of Women and Girls in Science 2019

The International Day of Women and Girls in Science is celebrated each year on 11 February since 2015, when it was adopted by the United Nations General Assembly to promote full and equal access to and participation in science for women and girls. This Day is a reminder that women and girls play a critical role in science and technology communities and that their participation should be strengthened. The celebration is led by UNESCO and UN-Women, in collaboration with institutions and civil society partners that promote women and girls' access to and participation in science.

Figure 1: Share of females enrolled in tertiary education by degree and employed in research, 2017



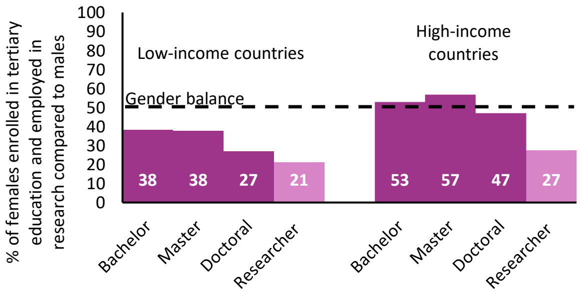
Balancing the gender scale among researchers

With UIS data from 2017 on the percentage of females enrolled in tertiary education globally (Figure 1), men (49%) and women (51 %) on average equally enrol in bachelor degrees, and women may show a slight overrepresentation in master degrees (53 %).

The three UIS subregions for Asia and the Pacific paint a similar picture of enrolling males and females almost equally. In Central Asia, a slight overrepresentation of female tertiary students can be recognized in master degrees, while they are only slightly under-represented in bachelor degrees in South and West Asia. A dip in the distribution of men and women in tertiary education is noticeable in doctoral degrees in East Asia and the Pacific and in South and West Asia, where 41 % of doctoral students are female.

A more significant shift in the distribution of men and women shows among the population employed as researchers. Globally, women comprise less than one in three researchers (29%). In South and West Asia, only about one in five women pursues a research profession, which stands in contrast to Central Asia where researchers are close to a gender balance speaking for every second researcher being a woman.

Figure 2: Percentage of females enrolled in tertiary education (2017) and employed in research (2015) compared to males

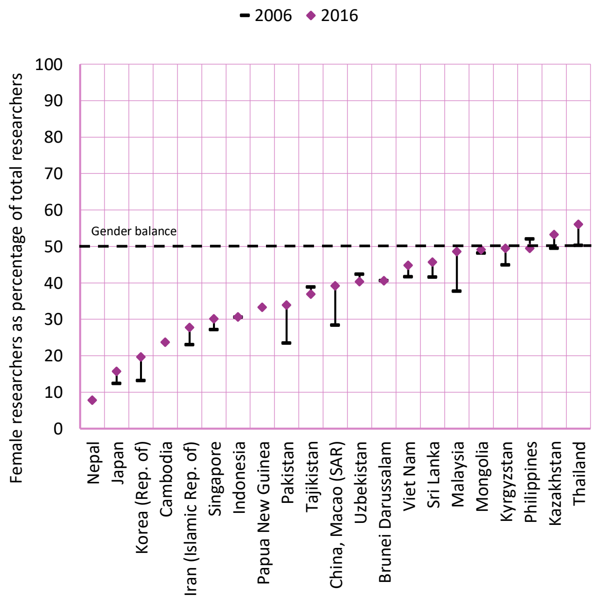


One might assume that the research profession finds a more gender-balanced participation in countries where the economy allows for greater investment in research as to offer more employment opportunities. The truth is, as seen in Figure 2, high-income countries and low-income countries by comparison show little difference in attracting women to or keeping women in research. In low-income countries, about one in five researchers are women; and about one in four are women in high-income countries.

***Definition of researchers:*[i]** *Researchers are professionals engaged in the conception or creation of new knowledge. They conduct research and improve or develop concepts, theories, models, techniques instrumentation, software or operational methods.*

Has there been any progress at all?

Figure 3: Female researchers as a percentage out of the total researchers, 2006 and 2016



Note: Viet Nam baseline comparison is 2011.

Diving into the countries for which data are available, an upward trend in the share of female researchers is noticeable (Figure 3). Yes, there has been progress. Between 2006 and 2016, the share of female researchers increased by up to 10.9%, as in the case of Malaysia where every second researcher accounts as female. China, Macao (SAR) made the second biggest leap in increasing its female share of researchers by 10.8%. Kazakhstan and Thailand with a gender balanced researcher population in 2006 further increased their share of female by 3.8% and 4.9%, pushing the share above a gender balanced distribution – a trend to look out for.

As hinted at by the low share of female researchers in high-income countries, two of the larger economic powerhouses in the region, Japan and the Republic of Korea, both retain a low share of female researchers, behind the lower-middle-income country of Cambodia (24%). In Japan about one in six (16%) and in the Republic of Korea about one in five (20%) researchers are female. These low percentages are the more significant to consider when recalling that we are looking at a time period of a decade during which income countries of lower classification made similar if not more progress.

So, when a high- or low-income country situation does not seem to make much of a difference to attracting woman into research, does expenditure on research activities attract female talent at all?

Increasing expenditure on research attracts women – Or does it?

Figure 6: Comparison: % of female researchers and GERD as % of the GDP

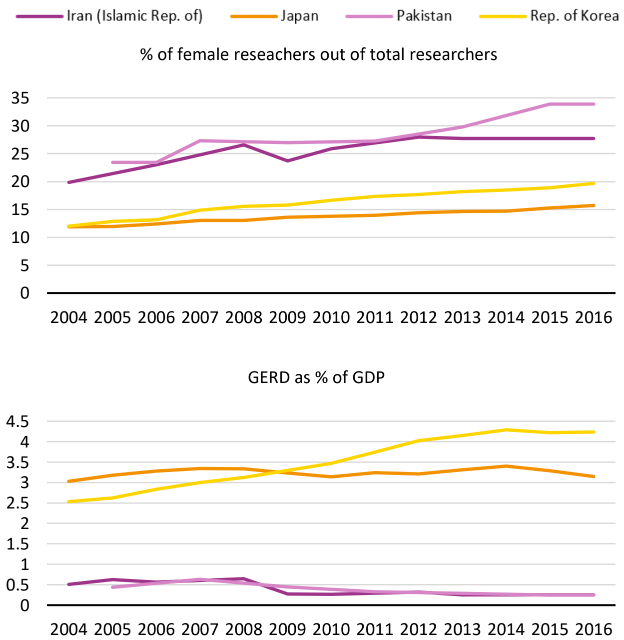
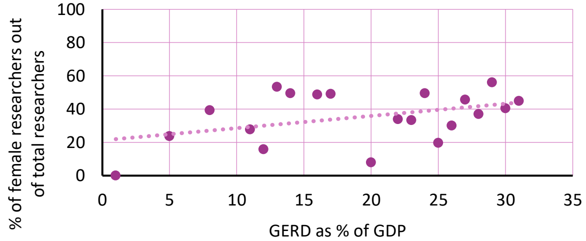
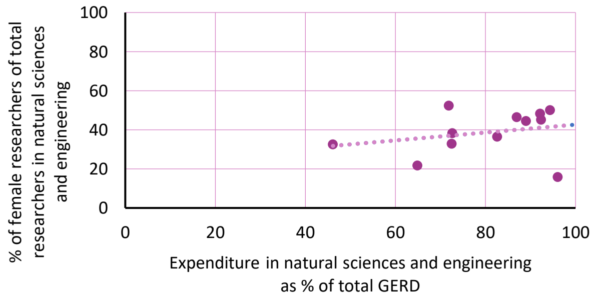


Figure 4: Share of females in research in relation to GERD of GDP, 2016



When comparing whether a higher gross expenditure on research and development (GERD) as a percentage of the gross domestic product (GDP) increases the share of females in research, the trend based on available data suggests a positive relation: For every increase of GERD of GDP, the share of female researchers increases, too (Figure 4).

Figure 5: Share of female researchers in natural sciences and engineering in relation to the expenditure in natural sciences and engineering out of the



The same trend holds true – perhaps truer – when dissecting the expenditure in natural sciences and engineering compared to the total GERD (Figure 5).[ii] For every increase of expenditure on research and development activities in the fields of natural sciences and engineering, the percentage of women in the same area of natural sciences and engineering increases, too.

However, …

Both Japan and the Republic of Korea have had the highest GERD of GDP in the region with 3.1% and 4.2% - higher than, for example, the United States of America (2.7%) or Germany (2.9%). They also have been the highest over the past decade between 2006 and 2016 – a time period during which, e.g., Pakistan and the Islamic Republic of Iran increased their share of female researchers on a lower and declining GERD of GDP (Figure 6). Yet, for both Japan and the Republic of Korea the remarkably high GERD has not translated into *boosting* the share of women in science overall.

Increasing the GERD can unarguably improve attracting scientific potential in general. Increasing the GERD nor accounting for a large GERD, however, should be understood as the solution to attracting specifically female research talents - or any other talents of any socio-demographic distinction.

Gender equality in the pursuit of excellence in science

The *L'Oréal Thailand-UNESCO for Women in Science* fellowship programme seeks to encourage young women between the ages of 25 to 40 to pursue excellence in science by awarding funding grants.

Website: https://www.forwomeninscience.com/

So, when there has been progress, where are the women in science?

While the picture is incomplete judging by the available data, female researchers are still predominantly found in the humanities and arts, social sciences, and especially the medical and health sciences (Figure 7). To some extent, women are also often found in agricultural and veterinary sciences. The greatest absence of women is noticeable in engineering and technology.

Can we expect then to find more women in science in the near future? The simple answer is "yes", as evidenced by the increase of female researchers up until 2016. The more complicated answer is that the current female generations are concentrated in non- science, -technology, -engineering, and -mathematics (STEM) areas (Figure 8). While there will be an increase for women in STEM following the trend, it will unlikely be *remarkable* unless collective action is taken.

One should not underestimate, though, that the medical and agricultural sciences also share many natural sciences subjects. In Nepal, research conducted in the field of microbiology is with 46% females compared 54% males not far apart.[iii]

Figure 7: Comparison of GERD by field as percentage out of the total GERD and the percentage of female researchers by field, 2016

% of female researchers out of total researchers

	Natural science	Engineering & technology	Medical & health science	Agricultural & veterinary science	Social science	Humanities & the arts
Cambodia	23	15	32	21	27	28
China, Macao SAR	26	18	42	n/a	45	47
Kazakhstan	52	45	66	46	65	63
Kyrgyzstan	47	39	45	44	60	56
Malaysia	48	47	50	51	50	50
Mongolia	49	40	72	56	38	n/a
Papua New Guinea	37	34	35	20	47	47
Philippines	55	41	64	52	n/a	66
Korea, Rep. of	28	11	46	27	37	51
Sri Lanka	45	32	55	50	43	n/a
Tajikistan	35	22	61	23	34	35
Uzbekistan	34	30	57	25	44	50

Note: The colour scale is meant for ease of presentation only and carries no judgement.

Sparks of hope

Strengthening STEM curricula for girls in Cambodia, Kenya, Nigeria and Viet Nam

UNESCO's IBE partners with the Malaysian Government on South-South cooperation to promote gender-responsive STEM education in Cambodia, Kenya, Nigeria and Viet Nam. The initiative mainstreams gender in educational policies, plans, curricula and teaching by developing country-contextualized, gender-sensitive guidelines. A *Resource Pack for Gender Responsive STEM Education* has been developed as practical guidance and training resource: *http://unesdoc.unesco.org/images/0025/002505/250567e.pdf*

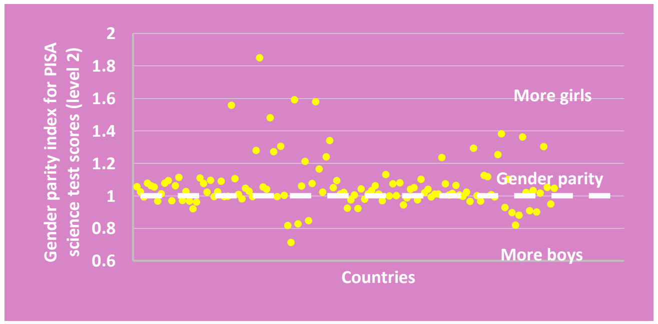
Currently, women in Asia-Pacific pursue predominantly business, administration and law degrees, followed by education, arts, humanities, and health-related degrees (Figure 8). Nevertheless, in several countries, 10% and more women have enrolled in degrees of engineering, manufacturing and construction by 2017 – including in the Republic of Korea. In natural sciences, mathematics and statistics degrees, there are also individual countries where at least 10% of women enrolled. An eye to keep out here is for Myanmar, where almost one third of its females have enrolled in the natural sciences, mathematics and statistics degrees.

Figure 8: Distribution of females across tertiary education subjects (%), 2017

	Business, Administration, Law	Education	Arts, Humanities	Health, Welfare	Social Sciences, Journalism, Information	Engineering, Manufacturing, Construction	Natural Sciences, Maths, Statistics	Services, other fields	Information, Communication Technologies	Agriculture, Forestry, Fisheries, Veterinary
Cambodia	64	11	6	5	1	1	3	3	2	5
Lao PDR	41	19	11	6	2	3	2	4	6	7
Thailand	37	11	11	6	9	5	5	12		3
China, Macao SAR	34	7	17	7	11	1	1	22	1	
Viet Nam	32	30	5	8	4	12	1	2	1	5
Malaysia	32	9	8	10	9	14	4	7	5	1
China, Hong Kong SAR	30	9	16	14	10	7	5	8	1	0
Philippines	30	27	2	7	6	8	1	7	8	3
Australia	29	14	11	25	7	3	5	3	1	1
Mongolia	29	20	8	16	6	8	3	6	1	2
Brunei Darussalam	27	11	25	5	1	11	12	0	8	
Kyrgyzstan	25	25	9	17	5	12	3	1	3	1
Iran, Islamic Rep. of	25	6	12	9	9	16	10	2	6	3
Bangladesh	24	1	35	1	25	2	9	0	2	1
Indonesia	21	27	7	14	15	4	4	0	4	4
New Zealand	21	11	13	20	13	4	8	5	3	2
Kazakhstan	19	32	7	15	3	12	3	4	2	3
India	17	4	6	5	39	8	16	0	4	0
Republic of Korea	15	10	23	18	8	10	6	8	1	1
Myanmar	6	1	42	2	6	6	31	1	2	2
Tajikistan	3	33	11	29	10	4	6	1	3	0
Korea, DPR	0	25	3	15	13	29	1	6	1	7

Being drawn to the non-STEM subjects must by no means indicate that young women would struggle more often than young men with the natural science-related subjects. On the contrary, girls in upper secondary education scored more often higher than boys in the Programme for International Student Assessment (PISA) 2015 test for science subjects from countries all around the world (Figure 9).[iv] The interest and the capabilities among women are indeed there.

Figure 9: Gender parity index among upper secondary students for PISA 2015 proficiency test in science



Source: World Inequality Database on Education (WIDE)

The root of inequalities

The cause of gender inequality in science is rooted in social norms that translate into gender stereotypical, cultural expectations, which influence parenting and teaching, and subsequently education, career choice and hiring practices.[v] Where society emphasizes on gender roles (masculinity vs femininity) society members set different goals for boys and girls and men and women; and strict sanctioning of gender-deviating behaviour guides young women to choose education and career paths according to these gendered expectations of their cultural environment.[vi] Providing access to STEM education alone will not solve the problem.[vii]

Biological factors as justification why women are better to focus on non-STEM subjects have been widely **invalidated** and come only into play in later stages of life when gender stereotypical upbringing has impacted on the brain's structure. If there is biological factor that impacts, it is childbearing as it requires time off of any engagement.

Economic factors stifle engagement with STEM among young girls in education when access to learning resources is barred by their parents' financial circumstances. In families where girls receive tutoring in mathematics and/or girls can regularly use a computer or tablet have been found to perform better in learning assessments of mathematics and science.[viii] A relation between the lack of economic resources and underrepresentation in science further extends into adulthood when women face barriers to e.g. accessing land, credit and/or ICT devices.[ix]

The problem starts as simple as early school leaving, with for example in Pakistan, where almost 50% of girls drop out due to poverty and the resulting cultural practices (early marriage) before touching on science classes in the upper levels of school.

Cultural factors pose as the highest barrier to women in science and engineering. [x] Parents, friends, teachers, employers, mentors all influence the choice females make by discouraging from decisions and interests due to these peers' own internalized gender biases. Gender stereotypes portrayed in the media, especially advertising, but also in school textbooks, cement a female's perception of gender roles in society.[xi]

Women are viewed as home-makers and are expected to carry the burden of household chores, raising children, caring for elders, etc.[xii] An attention-heavy and time-consuming science career is therefore unattractive. In the Republic of Korea, marriage influences labour participation for female but not male scientists: Before marrying, participation in natural sciences and engineering among all women with a relevant degree exceeds 84%; after marriage it decreases to 52% - contrasting 93% of male scientists.[xiii]

When women continue in science careers, they tend to be found in non-leadership positions as well as non-regular employment. In Bangladesh's academic institutions, less than 1% are women in the top executive positions, as discrimination and missing institutional support countered retention and promotion in the past.[xiv]

Cultivating opportunities for female scientists

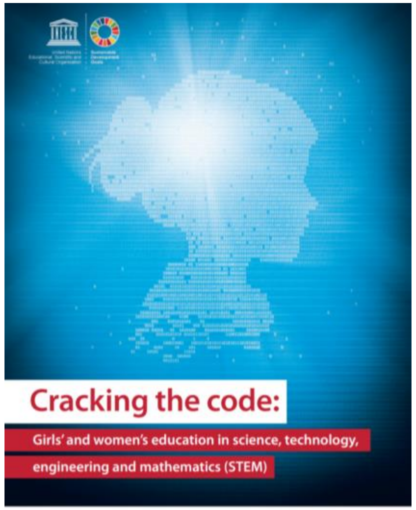
System-level changes are needed that uproot outdated traditional conceptions of a woman's position in society and in science.

To achieve system-level changes the **policy environment from the national to the local level** must address gender-balanced appointments and promotions as well as ensure family support mechanisms are provided to men and women. Findings showed that women have greater parity in countries with government policies that support health and childcare, equal pay, and gender mainstreaming.[xv] To this also accounts dismantling gender roles portrayed in the mass media.

The **promotion of female leadership** in science and technology, besides the direct benefit to gender-equal careers, benefits female curiosity in STEM studies and career. Competent female scientists serve as role models to young females to take up science and technology subjects as well as offer mentorship to science career- and family life-building – for both men and women.

Access to economic resources is another essentiality to grapple with female underrepresentation in STEM. At the individual level, women must be able to obtain financial credit independently from a husbands or other male guarantor in order to invest in herself. At academic institutions, scholarships and fellowships can be reserved for female students and researchers in areas where women are grossly underrepresented. Getting women to higher education and beyond first also requires providing families the means to get their children through a full cycle of free quality education as to ensure they at least have the chance to be curious about science subjects.

For an elaboration on the prevailing challenges and needed actions to tackle them, UNESCO has developed an ecological framework with intervention strategies as they can be applied by parents, teachers, the media, policy-makers and the wider peer network to increase girls' and women's engagement with STEM. For the details, see the UNESCO 2017 publication ***Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM)***.



Available at:

https://unesdoc.unesco.org/ark:/48223/pf0000253479

All data in this factsheet have been sourced from the UNESCO Institute for Statistics Data Centre (January 2018), unless indicated otherwise.

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[i] OECD, 2015: Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development. In: The Measurement of Scientific, Technological and Innovation Activities. Paris, OECD Publishing.

[ii] Natural sciences and engineering is comprised of: Natural sciences subjects (mathematics; computer and information-; physical-; chemical-; earth and related environmental-; biological; and other natural sciences); Engineering and technology (civil-; electrical-; electronic-; information-; mechanical-; chemical-; materials-; medical-; environmental-; environmental biotechnology-; industrial biotechnology-; nano-technology-; and other engineering); Medical and health sciences (basic and clinical medicine; health-; medical biotechnology-; and other medical sciences); Agricultural and veterinary sciences (agriculture, forestry, and fisheries; animal and dairy-; veterinary-; agricultural biotechnology-; and other agricultural sciences).

[ii] UNESCO, 2017: Cracking the Code. Girls' and women's education in science, technology, engineering and mathematics (STEM). Paris, UNESCO

[iii] AASSA, 2015: Women in Science and Technology in Asia. Gyeonggi-Do, The Association of Academies and Societies of Sciences in Asia.

[iv] The score refers to science proficiency level 2: "students are able to draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation…". For the full details, see: OECD, 2016: *PISA 2015 Results (Volume I): Excellence and Equity in Education*. Paris, OECD Publishing.

[v] For an elaborate overview, compare: UNESCO, 2017: Cracking the Code. Girls' and women's education in science, technology, engineering and mathematics (STEM). Paris, UNESCO.

[vi] Yoshikawa, Katsuhiko, Akiko Kokubo and Chia-Huei Wu, 2018: Cultural Perspective on Gender Inequity in STEM – The Japanese Context. *Industrial and Organizational Psychology*, Volume 11, Issue 2 June 2018, pp. 301-309.

[vii] Wisat, 2012: National Assessments on Gender Equality in the Knowledge Society Gender in science, technology and innovation Global Synthesis Report. Ontario, Organization for Women in Science for the Developing World.

[viii] UNESCO, 2017: Cracking the Code. Girls' and women's education in science, technology, engineering and mathematics (STEM). Paris, UNESCO

[ix] Wisat, 2012: National Assessments on Gender Equality in the Knowledge Society Gender in science, technology and innovation Global Synthesis Report. Ontario, Organization for Women in Science for the Developing World.

[x] AASSA, 2015: Women in Science and Technology in Asia. Gyeonggi-Do, The Association of Academies and Societies of Sciences in Asia; UNESCO, 2017: Cracking the Code. Girls' and women's education in science, technology, engineering and mathematics (STEM). Paris, UNESCO

[xi] Compare UNESCO, 2017: Cracking the Code. Girls' and women's education in science, technology, engineering and mathematics (STEM). Paris, UNESCO

[xii] AASSA, 2015: Women in Science and Technology in Asia. Gyeonggi-Do, The Association of Academies and Societies of Sciences in Asia.

[xiii] Ibid.

[xiv] Ibid.

[xv] Wisat, 2012: National Assessments on Gender Equality in the Knowledge Society Gender in science, technology and innovation Global Synthesis Report. Ontario, Organization for Women in Science for the Developing World.