UNESCO Asia-Pacific
Education Thematic Brief
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Closing the gender gap in STEM:

Drawing more girls and women into Science, Technology, Engineering and Mathematics

Background

A growing demand for professionals in Science, Technology, Mathematics and Engineering (STEM) is met with a significant labour shortage in these fields. Women are often underrepresented in STEM, and their low levels of participation can be traced back all the way to their school years, where a number of influences from society and culture, education and the labour market are all at play. Based on the findings of UNESCO Bangkok's 2015 publication - ***A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia***. Girls and Women in Science, Technology, Engineering and Mathematics in Asia – this brief highlights the importance of stimulating, encouraging and supporting fair and equal opportunities for girls to engage in STEM-related subjects at school, and to draw more girls and women into STEM fields of study and professions.

Why do we need more girls and women in STEM?

STEM fields are crucial for sustainable development as they enable us to find solutions to threats posed by global challenges such as climate change, global health epidemics, and increased income inequality.

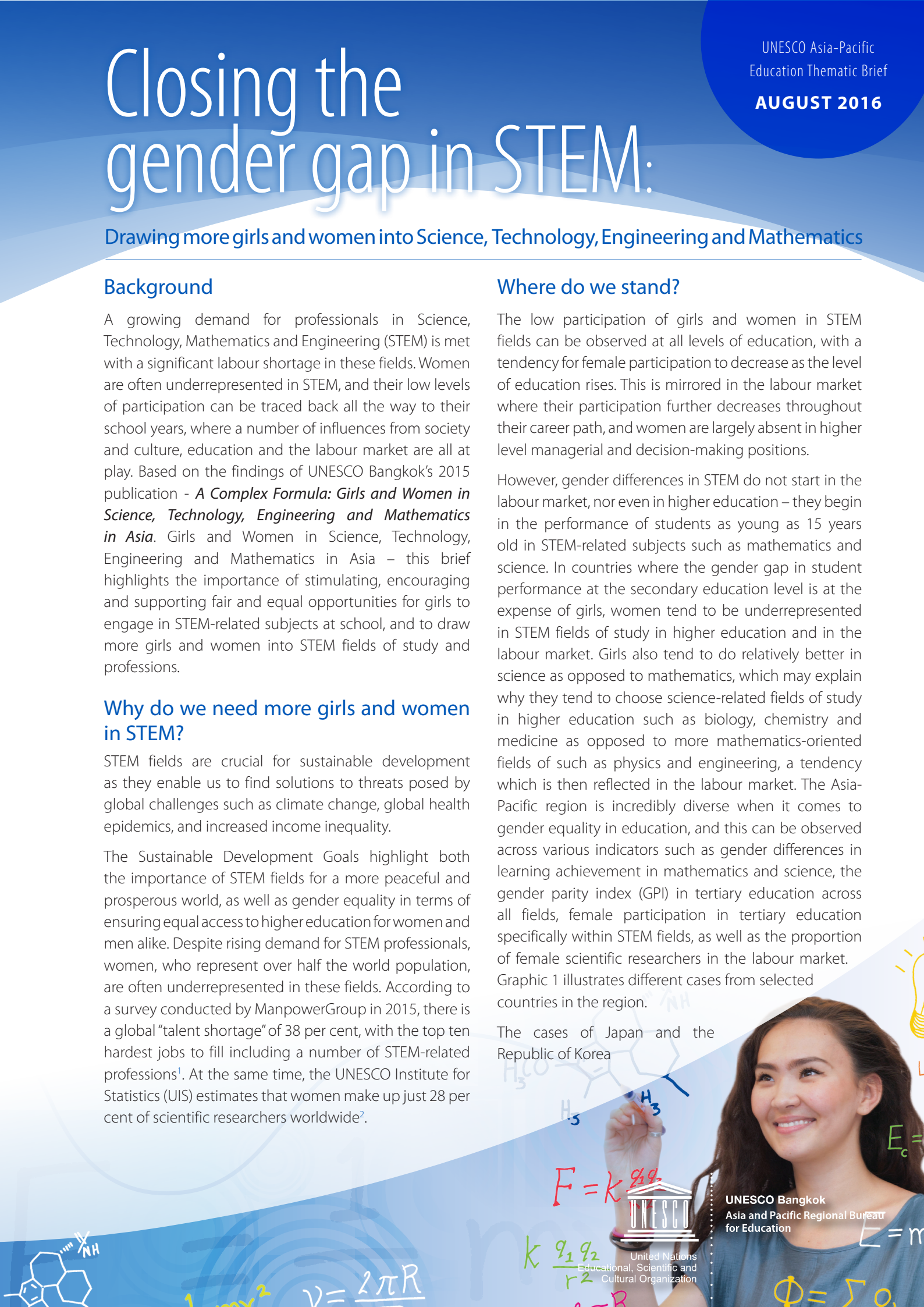
The Sustainable Development Goals highlight both the importance of STEM fields for a more peaceful and prosperous world, as well as gender equality in terms of ensuring equal access to higher education for women and men alike. Despite rising demand for STEM professionals, women, who represent over half the world population, are often underrepresented in these fields. According to a survey conducted by ManpowerGroup in 2015, there is a global "talent shortage" of 38 per cent, with the top ten hardest jobs to fill including a number of STEM-related professions[1]. At the same time, the UNESCO Institute for Statistics (UIS) estimates that women make up just 28 per cent of scientific researchers worldwide[2].

Where do we stand?

The low participation of girls and women in STEM fields can be observed at all levels of education, with a tendency for female participation to decrease as the level of education rises. This is mirrored in the labour market where their participation further decreases throughout their career path, and women are largely absent in higher level managerial and decision-making positions.

However, gender differences in STEM do not start in the labour market, nor even in higher education – they begin in the performance of students as young as 15 years old in STEM-related subjects such as mathematics and science. In countries where the gender gap in student performance at the secondary education level is at the expense of girls, women tend to be underrepresented in STEM fields of study in higher education and in the labour market. Girls also tend to do relatively better in science as opposed to mathematics, which may explain why they tend to choose science-related fields of study in higher education such as biology, chemistry and medicine as opposed to more mathematics-oriented fields of such as physics and engineering, a tendency which is then reflected in the labour market. The Asia-Pacific region is incredibly diverse when it comes to gender equality in education, and this can be observed across various indicators such as gender differences in learning achievement in mathematics and science, the gender parity index (GPI) in tertiary education across all fields, female participation in tertiary education specifically within STEM fields, as well as the proportion of female scientific researchers in the labour market. Graphic 1 illustrates different cases from selected countries in the region.

The cases of Japan and the Republic of Korea



indicate that boys outscored girls in mathematics and science in PISA 2012[3], and that a higher proportion of males are enrolled in tertiary education across all fields than females. Looking at student enrolment in STEM-related programmes at the tertiary level, a relatively low proportion are female, and in the labour market women make up only 15 percent of Japanese researchers and 18 per cent of Korean researchers in science, technology and innovation. By contrast, in Kazakhstan and Thailand more than half of researchers are female. In PISA 2012, Kazakhstan saw an equal score in mathematics and girls outscoring boys in science, whereas in Thailand girls outscored boys in both mathematics and science. In these two countries, more than half of students enrolled in science programmes are female; however in engineering, manufacturing and construction, they make up just 32 percent in Kazakhstan and 24 percent in Thailand. This may indicate the concentration of women within more science-based STEM fields as opposed to math-based STEM fields – a pattern which can be observed among many other countries in the Asia-Pacific region.

What led us here?

A number of factors are influencing the low participation of girls and women in STEM. These include wider sociocultural and labour market preconceptions which greatly affect career choices and perspectives among young people, especially with regard to which professions are perceived as well-suited for women or men. Education has a significant impact, particularly in terms of gender-sensitive policies and frameworks, teacher training and recruitment, as well as ensuring that learning materials are free of gender stereotypes. Psychosocial influences are also not to be underestimated, particularly in shaping student attitudes towards STEM-related subjects, which can greatly influence levels of achievement as well as future career choices and perspectives.

What is UNESCO doing?

As today's world requires more STEM professionals to find innovative solutions to global challenges, there is growing awareness of the importance of drawing more girls and

Graphic 1: Girls' and Women's Participation and Achievement in STEM

Country	Learning Achievement (difference in point score in PISA 2012)		GPI at Tertiary Level	Enrollment in STEM-related programmes at tertiary level (% female)		Proportion of Researchers (% female)
	Mathematics	Science	All fields	Science	Engineering, manufacturing & construction	Science, technology & innovation
Japan	♂ 18	♂ 11	♂ 0.91	25.32	12.2	15
Republic of Korea	♂ 18	♂ 3	♂ 0.75	31.11	17.85	18
Kazakhstan	⚥ 0	♀ 9	♀ 1.43	66.3	31.88	52
Thailand	♀ 14	♀ 19	♀ 1.34	52.96	23.67	53

Source: OECD, 2014; UIS, 2015

Note: Data by country as of latest available data. ♀ Symbol indicates point score difference or index in favor of women; ♂ symbol indicates point score difference or index in favor of men.

Box 1: Factors influencing low female participation in STEM

1	There are fewer female teachers in STEM-related subjects and at higher levels of Education
2	Gender-responsive teacher training in STEM-related subjects is lacking
3	Lack of resources and equipment with potential to stimulate interest in STEM subjects among girls
4	Teaching and learning materials still permeate gender stereotypes
5	Gender-responsive career counselling, scholarship and mentoring opportunities remain limited
6	Sociocultural, educational and other factors lead to gender differences in subject preferences and perceived performance
7	Females may experience higher rates of anxiety around mathematics and science subjects
8	Girls are less likely to be encouraged to study STEM subjects by parents and teachers
9	Female participation in the labour market and wages remain unequal
10	Gender stereotypes and norms lead to women within STEM being concentrated within specific occupations more than others
11	Lower female participation in STEM fields equates to fewer female role models for girls

women into STEM fields. UNESCO has been working on various projects that are building momentum around this issue, including the establishment and observation of the first ever International Day of Women and Girls in Science on 11th February 2016. Other ongoing initiatives include UNESCO's research on girls' education in science and mathematics which will investigate girls' and women's participation at a global level and the UNESCO Institute for Statistics (UIS)'s STEM and Gender Advancement project which aims to reduce the gender gap in STEM through analysis and development of new indicators to better understand the dynamics that influence women's participation and support evidence-based policy-making. Since April 2015, the UNESCO International Bureau of Education (IBE) and the Government of Malaysia have also been working together in strengthening STEM curricula, teacher education and assessment for girls and women. UNESCO's initiatives provide a glimpse into a growing movement across the world, and call upon Member-States to take action to draw more girls and women into STEM for a more peaceful and sustainable future.

References

1 ManpowerGroup. 2015. 2015 Talent Shortage Survey. http://www.manpowergroup.com/wps/wcm/connect/408f7067-ba9c-4c98-b0ec-dca74403a802/2015_Talent_Shortage_Survey-lo_res.pdf?MOD=AJPERES&ContentCache=NONE (Accessed 26 April 2016.)

2 UNESCO Institute for Statistics. 2015. Women in Science. http://www.uis.unesco.org/ScienceTechnology/Pages/women-in-science-leaky-pipeline-data-viz.aspx (Accessed 26 April 2016.)

3 OECD. 2014. PISA 2012 Results in Focus. What 15-year-olds know and what they can do with what they know. https://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf (Accessed 1 June 2016)

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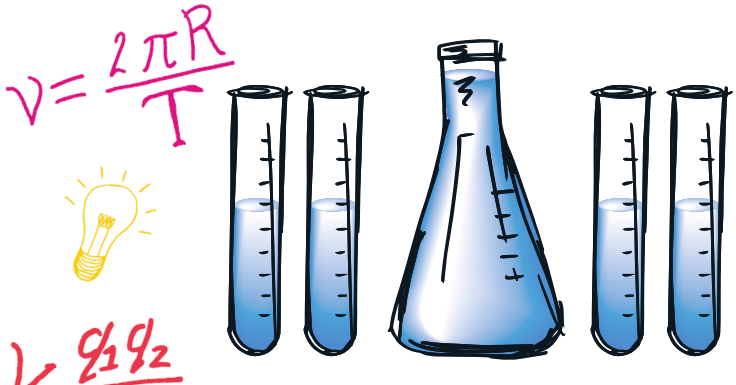

Policy recommendations

The Way Forward:

There are a number of implications for policymakers that could be considered in order to increase female participation in STEM fields of study and work. These include gender-responsive action across Ministries in order to create more opportunities for girls and women to study and pursue careers in STEM, as well as investment and review of education policies and frameworks to stimulate interest in STEM-related subjects among girls.

Data disaggregated by sex is needed to conduct in-depth analysis at country level and help provide a clearer picture of women and girls' participation within STEM. This data helps to inform policies and programmes for increased participation of women in STEM-related education and employment sectors.

Appropriate funding for equipment and resources should be allocated in order to stimulate student interest in STEM, particularly among female students. Allowing students to practically apply their learning in real-life situations as well as creative and hands-on experiments will not only contribute to enhancing the quality of learning but also increasing student interest in learning these subjects.

Structured and formalized **gender responsive career counselling** programmes should be considered in order for both female and male students to have support and objective guidance as they begin to shape their career choices.

Curricula and learning materials should undergo further rigorous review from a gender perspective to ensure that they do not perpetuate gender stereotypes. This involves a representative group of stakeholders with male and female experts in order to ensure different perspectives.

Support programmes and initiatives for female STEM professionals would help to address some of the factors which can cause them to discontinue their careers, including family responsibilities. This will equip them with the most up-to-date knowledge and skills in fields which experience fast-paced change and innovation.

Scholarship programmes targeted at women and girls in STEM would also contribute to increased opportunities for young women to pursue further study and eventually careers in STEM fields.

For the effective implementation of gender-sensitive STEM policies, **coordination between ministries** must be strengthened. This may involve joint programmes across various government sectors such as ministries of education, women's affairs or gender equality, science, technology and innovation, and labour.

Promoting **more female role models in STEM fields**, whether female teachers in mathematics and science at the secondary level, female students and faculty members in higher education, and more broadly more women working in STEM fields, is an important strategy to attract women and girls into STEM fields.

Teacher education, be they pre-and in-service programmes, should ensure that teachers are trained in **gender responsive teaching strategies** so that female and male students can develop their full potential in STEM-related subjects.

Teacher education and policies on recruitment must ensure a fair representation of both male and female teachers in all subjects, especially In STEM and at all levels of education.

Recommendations extracted from *A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia*. (UNESCO Bangkok and KWDI, 2015). Download the publication here:

Gender-responsive action from governments, through education and labour market policies, enforcement of gender-related laws, as well as specific initiatives for advocacy and awareness raising, is needed to attract more women and girls into STEM fields.