



POLICY BRIEF

STRENGTHENING ASEAN WOMEN'S PARTICIPATION IN STEM

December 2022

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ACRONYMS

ACT/EMP	Bureau for Employers' Activities, International Labor Organization
ADB	Asian Development Bank
AGMSF	ASEAN Gender Mainstreaming Strategic Framework
AMS	ASEAN Member States
APASTI	ASEAN Plan of Action on Science, Technology, and Innovation
ASEAN	Association of Southeast Asian Nations
ASEAN-USAID IGNITE	ASEAN-USAID Inclusive Growth in ASEAN through Innovation, Trade, and E-Commerce
BCG	Boston Consulting Group
COSTI	Committee on Science, Technology, and Innovation (ASEAN)
DO-IT	Disabilities, Opportunities, Internetworking, and Technology
ERIA	Economic Research Institute for ASEAN and East Asia
GBV	Gender-based violence
GESI	Gender equality and social inclusion
ICT	Information and communications technology
IEM	Institution of Engineers Malaysia
ILO	International Labor Organization
LGBTQ2+	Lesbian, gay, bisexual, transgender, queer, or two-spirit
NTU	Nanyang Technological University, Singapore
PCIEERD	Philippine Council for Industry, Energy, and Emerging Technology Research and Development
PISA	Program for International Student Assessment
POWERS	Promotion of Women in Engineering, Research, and Science
SHEPII	Second Strengthening Higher Education II (project)
STEM	Science, technology, engineering, and math
STI	Science, technology, and innovation
TMISS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children's Emergency Fund
USAID	United States Agency for International Development
WEF	World Economic Forum

WHWise

Women-Helping-Women: Innovating Social Enterprises (program)

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The principal authors of the brief are Caroline Rubin and Eko Utomo of the ASEAN-USAID IGNITE project. The authors are grateful for the contributions and insights of several individuals and organizations, including Dr. Bambang Irawan of the ASEAN-USAID IGNITE project; Lis Meyers of Nathan Associates; Dr. Zurina Moktar and Dr. Vanny Narita of the Science and Technology Division of the ASEAN Secretariat; and the ASEAN Committee on Science, Technology, and Innovation (COSTI).

Foreword

By H.E. Dr. Kao Kim Hourn, Secretary-General of ASEAN

Across the world, women have defied societal norms and overcome the challenges to excel in Science, Technology, Engineering, and Mathematics (STEM) disciplines. Their dedication, intellect, and relentless pursuit of knowledge have not only propelled them to the forefront of their respective fields but have also inspired future generations of women to pursue careers in STEM.

In the ASEAN region, female students demonstrate exceptional aptitude and excellence in mathematics and science throughout their academic years, surpassing their male counterparts in several countries within the region. However, this remarkable academic prowess does not consistently translate into a commensurate representation of women in STEM careers as they advance in their professional trajectories. In this regard, it is important to acknowledge that gender disparities still persist in the STEM landscape, where women in STEM can still face many challenges, such as biases, stereotypes, and limited opportunities for advancement.

It is projected that approximately 90 percent of future jobs will require STEM skills. The release of this Policy Brief on Strengthening ASEAN Women's Participation in STEM comes at a crucial moment, as we look towards increasing the involvement of ASEAN women in STEM fields. This document, therefore, marks a significant milestone as it presents a comprehensive evaluation of women's involvement in STEM-related fields and professions within ASEAN.

Through meticulous research, the policy brief encompasses the latest data on women's representation in STEM across countries where such information is accessible. More importantly, the brief offers actionable suggestions to the ASEAN Member States in fostering increased participation of women in critically significant endeavours that underpin economic advancement.

ASEAN, through the Committee on Science, Technology and Innovation (COSTI), takes great pride in its collaboration with the United States Agency for International Development (USAID) in the development of this policy brief. I firmly believe that the document will serve as a valuable resource and guiding light for women scientists, researchers, and technology workers throughout ASEAN. It recognizes the importance of partnerships, mentorship programs, and supportive ecosystems that provide women with the necessary resources, encouragement, and opportunities to succeed.

Now is the time for us to take collective action. By creating an inclusive and supportive environment, we can empower ASEAN women in STEM and unlock their full potential. This requires a multi-faceted approach that addresses systemic barriers, provides mentorship and networking opportunities, and promotes policies that foster gender equality in education, research, and professional development.

I would like to extend my heartfelt appreciation to all the contributors, researchers, advocates, and change-makers who have dedicated their time and efforts to promoting the

participation of ASEAN women in STEM. Your work is instrumental in breaking down barriers, challenging stereotypes, and creating a more equitable and inclusive society.



DR. KAO KIM HOURN

Secretary-General of ASEAN

Foreword

By Yohanes A. Abraham, U.S. Ambassador to ASEAN

The U.S. Government is proud to join the Association of Southeast Asian Nations (ASEAN) in releasing the policy brief on Strengthening ASEAN Women's Participation in STEM. This joint effort, led by ASEAN's Committee on Science, Technology and Innovation (COSTI) and the U.S. Agency for International Development (USAID), reflects our commitment to elevate women's participation and leadership in science, technology, engineering, and mathematics (STEM) fields to foster sustainable, inclusive, and transparent economic growth in the region through the promotion and incorporation of women. The policy brief focuses on shared strategic priorities for both the United States and ASEAN to improve women's economic security and accelerate economic growth. These priorities were underscored in the 2022 [Joint Statement](#) released after the ASEAN – U.S. Ministerial Dialogue on Gender Equality and Women's Empowerment.

The United States engages with ASEAN countries through the annual ASEAN-U.S. Consultation on Science and Technology to promote STEM initiatives in the region. The U.S. Government commends ASEAN COSTI's important work to encourage greater participation of women in STEM fields. In 2021 and 2022, USAID collaborated with ASEAN COSTI to deliver the Women in STEM Webinar Series, which informed the development of this policy brief to examine the status of women working in STEM across the ASEAN region.

In 2023, USAID released a Gender Equality and Women's Empowerment Policy that underscores the commitment to gender equality and women's empowerment in all sectors including STEM fields. This initiative builds on the U.S. Government's 2021 National Strategy for Gender Equity and Equality, which discusses the U.S. strategy to advance the full participation of all people in the United States and around the world. As we embrace the challenges and opportunities of the 21st century, it is imperative to harness the full power of our collective intellect and creativity. Women are integral parts of this equation.

Today's economy requires skills that meet the challenges of an ever-evolving landscape using science, technology, and innovation. The Strengthening ASEAN Women's Participation in STEM policy brief represents the first systematic assessment of ASEAN's women participation in STEM-related fields and careers with ASEAN countries. Further, the policy brief provides actionable recommendations for how ASEAN countries can lift participation of women and girls in the STEM sector to enhance economic growth. The brief also highlights examples of cooperation to further shared goals in STEM through partnership, such as USAID's collaboration with ASEAN and Underwriters Laboratories for the ASEAN-U.S. Science Prize for Women activity. This annual competition, which recognizes achievements of women scientists in ASEAN, will celebrate its 10th anniversary in 2024, marking a decade of ASEAN-U.S. collaboration on this important issue, and demonstrating the United States' enduring and durable commitment in the region.

The U.S. Government hopes that this policy brief will not only highlight barriers that have historically hindered the full participation of women, but also offer ways to address these challenges. We are certain that creating opportunities for women in STEM will promote

both economic growth and inclusive development, and we look forward to our continued partnership with ASEAN to realize these goals.

A handwritten signature in black ink, appearing to read 'Y. Abraham', with a long horizontal flourish extending to the right.

Yohannes A. Abraham

U.S. Ambassador to ASEAN

I. INTRODUCTION

The ASEAN region's fast-growing digital economy paired with the potential to be a global leader in innovation contribute to the prospect of a highly competitive region on the global stage. A vital part of this is realizing a workforce that is equipped with the necessary skills for jobs in the science, technology, engineering, and math (STEM) fields. By 2030, up to 80 percent of jobs in the ASEAN region will require workers with basic digital literacy as well as applied skills in information and communications technology (ICT) (The Sasakawa Peace Foundation and Dalberg Global Development Advisors 2017). However, women in the region are currently concentrated in sectors such as services that require little or no ICT skills. To improve women's labor force participation and ensure the region is equipped for an increasingly digitally driven economy, governments must equip women with digital literacy and ICT capacity and skills so that women are not left behind.

Women face obstacles in entering, remaining in, and advancing in STEM jobs – from personal and cultural barriers to structural and systemic challenges. The resulting low participation of women in STEM fields, including as STEM business founders, inhibits their career and economic opportunities, keeping them from lucrative career paths that can provide financial stability and independence.

Women's participation in STEM careers – as entrepreneurs, employees, researchers, and leaders – is also critical to achieving innovation and sustainable economic growth in the ASEAN region. Greater participation of women in STEM careers can diversify management and leadership styles, lead to more effective application of knowledge and use of data, and create new products and markets for science knowledge (United Nations Educational, Scientific, and Cultural Organization (UNESCO) 2018a). Further, inclusion of diverse women who represent racial or ethnic minorities, have a disability, or are LGBTQ2+ (lesbian, gay, bisexual, transgender, queer, or two-spirit) has demonstrated increased creativity among workforces (UNESCO Office Bangkok and Korean Women's Development Institute 2015).

Harnessing women's talents and innovations by facilitating access to STEM fields will enable the region to tackle many of its most pressing challenges – from global pandemics to food insecurity to climate change, among others. If governments and stakeholders in the region can remove the barriers women are facing and enable their full participation, the region's STEM industries will power ASEAN's growth to a vibrant future.

BACKGROUND AND CONTEXT

ASEAN has recognized the importance of collectively working to ensure that women across the region are equipped and supported to lead the region's progress in science, technology, and innovation. The ASEAN Plan of Action on Science, Technology and Innovation (APASTI) 2016–2025 (hereinafter “APASTI 2016–2025”) serves as a guide for the Committee on Science, Technology and Innovation (COSTI) to develop policy and mechanisms in science, technology and innovation cooperation that align with the ASEAN Economic Community Blueprint 2025. Throughout the guiding document, it highlights the need to engage women in interventions in science, technology and innovation:

- One of the APASTI 2016–2025 goals is “an innovation-driven economy with a deep science, technology, and innovation (STI) enculturation and a system of seeding and sustaining STI by leveraging ICT and the resources of our talented young, women, and private sectors” (ASEAN Secretariat 2017). This provides a basis for COSTI and relevant ASEAN

stakeholders to ensure that women are part of the human resources that will achieve an innovation-driven economy.

- As noted in the APASTI 2016–2025, the 69th ASEAN Committee on Science and Technology Meeting adopted a proposed STI measure on the role of science and technology to promote women’s entrepreneurship in the ASEAN Economic Community Post 2015 Attendant document, Element F, Science and Technology (under Pillar 4: Enhanced Sectoral Integration) includes “establish systems and mechanisms that will increase the engagement of women and youth in STI to promote entrepreneurship” (ASEAN Secretariat 2017).
- The APASTI 2016–2025 Strategic Thrust 2 is to “Enhance mobility of scientists and researchers, people-to-people connectivity and strengthen engagement of women and youth in STI” (ASEAN Secretariat 2017).

In collaboration with the U.S. Agency for International Development (USAID), COSTI has undertaken several initiatives and activities to meet the above measures. These include the Underwriters Laboratories-ASEAN-U.S. Science Prize for Women and the ASEAN Women in STEM Webinar Series. Underlying COSTI’s work to advance women in STEM is ASEAN’s commitment to gender mainstreaming in all pillars and sectors including in science, technology, and innovation.

The ASEAN Gender Mainstreaming Strategic Framework (AGMSF), launched in January 2022 with support from USAID, establishes concrete steps for a whole-of-ASEAN approach to mainstreaming gender in ASEAN’s work across all pillars. It builds on a long history of efforts to advance ASEAN’s gender equality commitments. This approach, in alignment with the Sustainable Development Goals, will help to ensure that ASEAN improves gender equality in all sectors, including those in the ASEAN Economic Community.

This policy brief aims to support COSTI in its implementation of the APASTI 2016–2025 as well as support initial gender mainstreaming efforts as mandated by the AGMSF.

Defining STEM

The APASTI 2016–2025 does not explicitly define STEM and definitions vary by ASEAN Member State. While it is generally understood that STEM stands for science, technology, engineering, and math, there is no standard definition of STEM industries, especially regarding occupations. For instance, there may be STEM-related roles in industries not traditionally considered as STEM, such as energy. STEM occupations can be further identified based on the highest level of education achieved. For example, UNESCO defines a STEM occupation as one requiring an advanced degree. Generally, however, the STEM fields are interrelated and interdependent and, as a result, many careers incorporate more than one field. STEM professions are relatively high-paying, stable, and in-demand across most levels of education and job positions.

The lack of a clear-cut definition of STEM has led to data that are based on a wide range of definitions, and often is not straightforward as to whether particular data fit within STEM. For instance, in much of its data, the International Labor Organization uses the International Standard Industrial Classification of All Economic Activities (ISIC), which does not specify STEM as a type of economic activity. More precise and agreed-upon definitions of STEM not only in ASEAN, but globally, would help ensure more comparative data. Further, it may help pinpoint specific STEM occupations or areas where women are underrepresented that are otherwise unknown. This data would help make the case to better understand and address the barriers women face in accessing those occupations.

OBJECTIVES AND STRUCTURE

This policy brief aims to provide concise information, analysis, and recommendations on the status of women's participation, representation, and leadership in STEM fields and the presence of policy efforts to enable their participation across the ASEAN region to better equip policymakers and key stakeholders with the information needed to close gender gaps in STEM fields. It is intended that this policy brief provide a foundation for the following stakeholders to further engage and implement initiatives around women in STEM in the future:

- The ASEAN Ministerial Meeting on Science, Technology and Innovation (AMMSTI) that is responsible for overseeing the overall implementation of the APASTI 2016–2025
- The ASEAN Committee on Science, Technology and Innovation (COSTI) that is responsible in operationalizing and translating the APASTI strategic thrusts into specific actions
- The Board of Advisers to COSTI who will advise ASEAN COSTI on the implementation of the APASTI 2016-2025, and the development of APASTI 2026-2035
- The COSTI Sub-Committees that are responsible to develop their respective work programs that would clearly describe the targets, milestones, and strategies in implementing specific activities consistent with their new thematic priorities and the APASTI 2016–2025 goals and strategic thrusts, in general
- The ASEAN Secretariat Science and Technology Division that supports and facilitates COSTI in substantial and technical implementation of APASTI 2016–2025 activities and programs

The findings in this policy brief are based on an extensive review of 74 policies and online studies, reports, as well as databases from governmental, international, civil society, and research organizations. The research draws from regional and international studies and multilateral organizations, including the United Nations, the World Economic Forum, the International Labor Organization (ILO), and the World Bank. Relevant ASEAN frameworks, strategies, measures, and action plans were also reviewed. The analysis was bolstered by the learnings from the ASEAN Women in STEM Webinar Series and past winners of the Underwriters Laboratories-ASEAN-U.S. Science Prize for Women.

This policy brief is organized as follows: it begins with a snapshot and summary of women's participation in STEM in ASEAN, followed by analysis on the barriers to their participation. The policy brief subsequently outlines ASEAN's efforts to support women's participation in STEM, including trends and successful examples. The policy brief closes with immediate and strategic policy recommendations and solutions to enhance and advance women's participation in STEM at the regional level.

II. THE STATUS OF WOMEN'S PARTICIPATION IN STEM IN ASEAN

WOMEN'S EDUCATION AND ACHIEVEMENT IN STEM

While girls in primary and secondary education in several ASEAN Member States (AMS) have greater mathematics and science achievement than boys, this does not necessarily translate into undertaking further STEM education or ultimately careers. Where girls and women can choose what to study, generally, the gender gap amongst STEM students widens as education levels increase. Nonetheless, the ASEAN region is ahead of most of the world in girls' STEM education, which bodes well for women's representation in certain STEM occupations, such as researchers, which is elaborated further below.

PRIMARY AND SECONDARY EDUCATION

In all 10 AMS, primary education is compulsory, fully publicly funded, and provided by the government universally, regardless of a family's income level (World Bank 2018). Results of the 2019 Trends in International Mathematics and Science Study (TIMSS) reveal early indications of gendered differences in STEM achievement using grade 4 data for the Philippines and Singapore, the only AMS covered by the dataset. Girls outperformed boys in the Philippines in mathematics, with the largest gender gap of all 58 participating countries. Girls in the Philippines also outperformed boys in science. Boys outperformed girls in Singapore in mathematics and science, though by a small margin (Mullis et al. 2020).

Out of six AMS where data is available, girls in five AMS – Brunei Darussalam, Indonesia, Malaysia, the Philippines, and Thailand – outperformed boys in mathematics and science on the 2018 OECD Program for International Student Assessment (PISA), which measures 15-year-olds' ability to use their reading, mathematics, and science knowledge and skills to meet real-life challenges (OECD 2018).¹ Girls also had higher harmonized test scores in 2020 in all AMS where data is available: Brunei Darussalam, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam (World Bank n.d.).² While girls scored higher on average than boys, girls in Cambodia, Indonesia, Malaysia, and Vietnam perceive their performance to be lower in STEM than in other subjects, which may hinder their confidence and willingness to pursue STEM (UNESCO Office Bangkok and Korean Women's Development Institute 2015). Young girls' achievement and confidence in their STEM abilities can be reinforced through activities such as tutoring. A study in Cambodia, Indonesia, Malaysia, Mongolia, Nepal, South Korea, and Vietnam showed that more girls received private tutoring than boys across all subjects, including STEM (UNESCO 2017).

The superior performance by girls does not necessarily translate to girls studying all STEM topics. For instance, in Malaysia, women comprise 33.9 percent of enrollment in engineering courses and 40.2 percent in ICT courses in secondary school, even though girls have outperformed boys in standardized math and science tests for the past decade (World Bank 2019). In addition, girls with disabilities may not have the opportunity to pursue studies in STEM fields, as traditional STEM

¹ Girls underperformed boys in Singapore in both mathematics and science.

² Data from 2020. Test scores included are TIMSS (Trends in International Maths and Science Study) and PIRLS (Progress in International Reading Literacy Study); PISA (Program for International Student Assessment); PASEC (Program of Analysis of Education Systems); EGRA (nationally-representative Early Grade Reading Assessments); and EGRANR (non-nationally-representative Early Grade Reading Assessments).

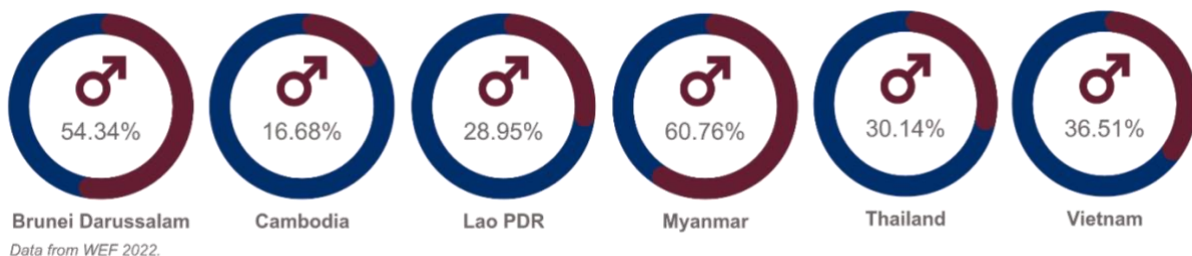
education often involves laboratory work and fieldwork, which is frequently unaccommodating (UNICEF and the International Telecommunication Union 2020).

Nonetheless, 68 percent of girls between the ages of 12 and 14 in the Asia-Pacific region surveyed by Mastercard found STEM subjects interesting. In the same survey, 22 percent indicated they want to be a doctor and 18 percent indicated they want to be an engineer (Mastercard 2018). These encouraging results indicate that the interest in STEM is present in girls from a young age. However, the same survey demonstrates that age 15 is when girls decide whether they take a STEM path: “Although half of 15–19-year-olds considered STEM related subjects when they were young, half changed their minds, and by 17–19 only 12 percent continued studying STEM subjects.” The most commonly reported influence for girls pursuing a career in STEM was parental encouragement (49 percent), followed by support from schools and institutions (29 percent), observing women role models (36 percent), and scholarships (38 percent) (Mastercard 2018). Notably, global research demonstrates that, “parents with higher socio-economic status and higher educational qualifications tend to have more positive attitudes towards STEM education for girls than parents with lower socio-economic status and education, of immigrant status, and ethnic minority background or single parents” (UNESCO 2017).

TERTIARY EDUCATION

Tertiary education, or higher education, is where the gendered patterns in STEM become most evident. While more women participate in higher education than men in Southeast Asia, women are underrepresented in STEM disciplines across several ASEAN Member States. Just one in six students majoring in STEM are women (ILO 2016).

Figure 1: Percentage of Female Tertiary Graduates from STEM Programs



In ASEAN, on average, 19.3 percent of women graduates obtained STEM degrees (out of all women graduates), while roughly double the proportion of men (39.8 percent) obtained STEM degrees (out of all men graduates). Though this is a substantial gender gap, the global average gap is nearly double (37.4 percent), indicating that ASEAN is at the forefront of countries curbing this disparity (World Economic Forum (WEF) 2021). The small proportion of women who are studying STEM are concentrated in science-related fields, such as biology, chemistry, and medicine, rather than physics and engineering (UNESCO 2015).

Table 1: Percentage of Female Tertiary Education Graduates by Field (WEF 2022)

AMS	Engineering, Manufacturing, & Construction	Information & Communications Technology	Natural Science, Mathematics, & Statistics
Brunei Darussalam	52.26%	-	73.37%
Cambodia	-	8.44%	34.08%
Indonesia	24.92%	34.67%	-
Lao PDR	17.95%	40.82%	55.00%
Malaysia	27.05%	46.00%	70.73%
Myanmar	42.34%	-	66.38%
Philippines	24.48%	48.13%	61.97%
Singapore	-	32.22%	61.72%
Thailand	-	47.85%	70.72%
Vietnam	-	-	50.59%

Women also account for a minority of doctoral degree holders across several AMS, although Myanmar and the Philippines are the exception. Retention is an issue at all levels of STEM education, with the highest attrition rate at the post-doctoral level.

Many women holding doctoral degrees do not continue to jobs in their doctoral field of study. Gender norms around working in STEM fields, family obligations, and the working environment and conditions impact women’s transition into STEM careers from doctoral studies (UNESCO 2017). These challenges are elaborated in Section 3 below.

Table 2: Percentage of Population Ages 25 and Over that Attained or Completed a Doctorate or Equivalent, Disaggregated by Sex (2022 data) (World Bank n.d.)

AMS	Year	Male	Female
Cambodia	2015	0.201	0.000
Indonesia	2020	0.060	0.029
Malaysia	2019	0.271	0.258
Myanmar	2019	0.040	0.054
Philippines	2019	0.101	0.127
Thailand	2019	0.127	0.052
Vietnam	2019	0.110	0.040

THE TRANSITION FROM STEM EDUCATION TO WORK

Women studying STEM do not always transition into STEM careers for several reasons, which are further described in Section 3 below. For instance, in Singapore, women who graduate with a STEM diploma or degree (58 percent) are less likely to work in STEM compared to men with a STEM diploma or degree (70 percent), in spite of the majority of women with STEM degrees indicating interest in a STEM job (Chua et al. 2022). This may be due to women being less confident in their math and science skills and more likely to perceive gender barriers of STEM career entry, in comparison to men, as well as employer bias in the recruitment and hiring of women.

However, the same research from Singapore found that a greater proportion of women working in STEM fields do not have STEM degrees as compared to the proportion of men working in STEM fields without STEM degrees. A similar trend occurs in technology careers across the ASEAN region. Women comprise 39 percent of technology majors in Southeast Asia (compared with 56 percent for all other fields of study). Yet, women comprise 32 percent of the region’s technology sector

(compared with 38 percent of the total workforce) (Boston Consulting Group (BCG) 2020). This points to a trend in several AMS – including Singapore and Thailand – where booming technology industries are attracting women from non-technology educational backgrounds (Kaur 2020).

WOMEN’S EMPLOYMENT IN STEM

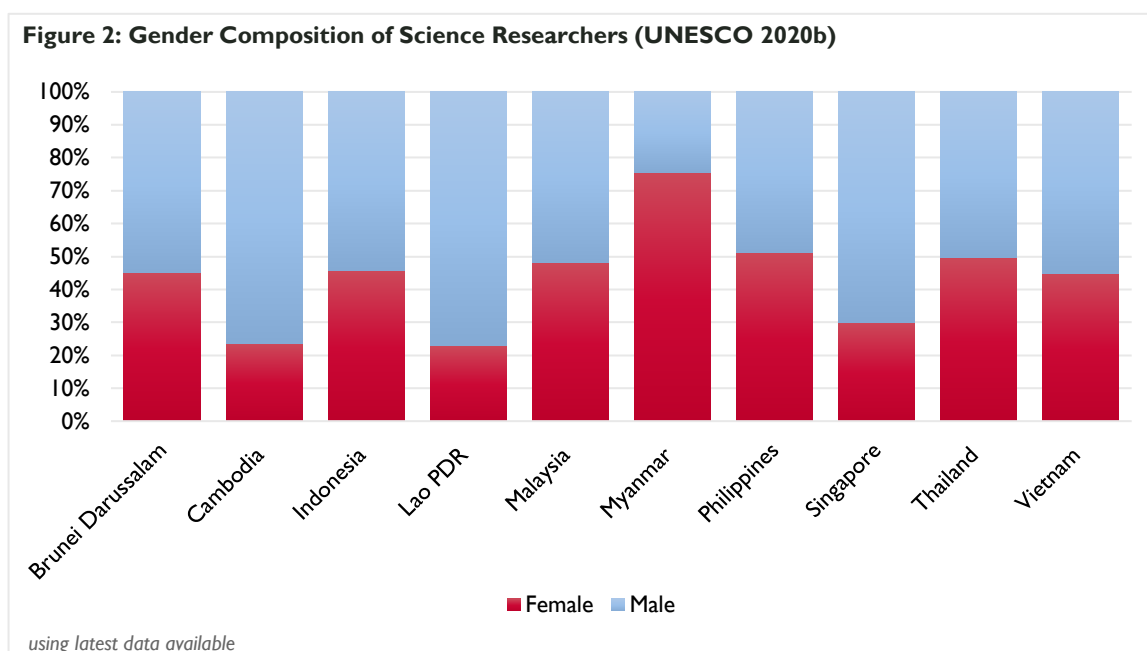
Women are employed in STEM fields in a number of capacities – ranging from researchers to engineers, and many in between. The ASEAN region has made progress in the representation of women employed in STEM, particularly in numbers of women researchers, and with several countries leading the way even on the global scale. However, more remains to be done, particularly in fields such as engineering where women account for a minority of workers in several AMS.

Table 3: Female Researchers as a Share of Total Researchers by Field (%) (Bello et al. 2021)

AMS	Year	Natural Sciences	Engineering & Technology	Health & Welfare	Agricultural Sciences	Social Sciences & Humanities
Brunei Darussalam	2018	40.7	28.7	66.2	33.3	48.1
Cambodia	2015	23	14.8	31.6	20.8	27.4
Malaysia	2015	47.8	47.2	50.3	50.5	50.2
Myanmar	2018	72.7	78.5	72	75	70.8
Philippines	2018	54	42.9	64	53.4	56.2

Women researchers are employed by a variety of entities and conduct research in a multitude of fields. For instance, in Thailand, women comprise 54.2 percent of researchers in government, higher education institutes, public enterprises, and private nonprofit organizations, while they comprise 47.5 percent of researchers in industry (UNESCO 2018a). In several AMS, women researchers are concentrated in health and social sciences, which is consistent with the global norm. While women comprise a minority of researchers across the fields listed in Table 3, notably, Myanmar is one of the few countries in the world to achieve a greater percentage of women researchers than men researchers in engineering and technology.

Figure 2: Gender Composition of Science Researchers (UNESCO 2020b)

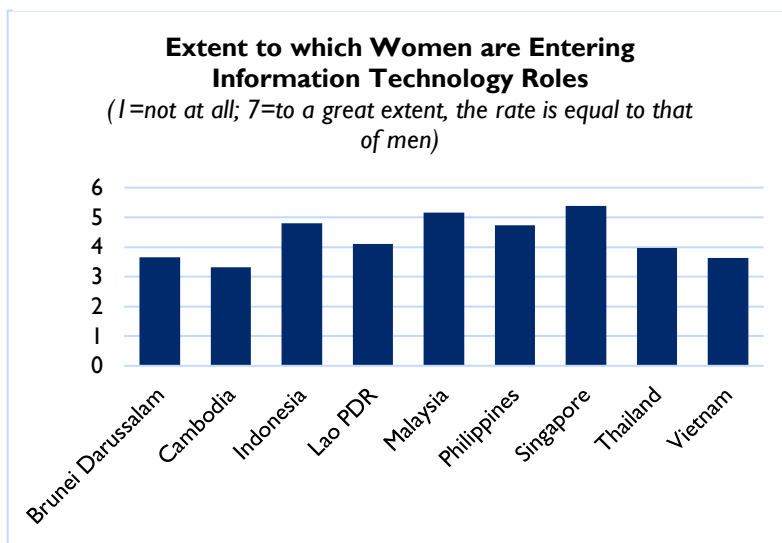


Myanmar and the Philippines are the only two AMS where women account for a higher proportion of science researchers than men, as shown in Figure 2. However, the ASEAN region as a whole and most AMS individually surpass the global average percentage of women science researchers.

Further, while AMS including Myanmar and the Philippines have surpassed gender parity in certain areas of STEM, this may not be true across all geographic areas. For instance, most women in science and technology in the Philippines are concentrated in the National Capital Region, Central Luzon, and Calabarzon (Department of Science and Technology 2021).

Women in Southeast Asia are better represented (32 percent) in the technology sector than globally (28 percent) (BCG 2020). Thailand and Singapore lead the way, with women accounting for 42 percent and 41 percent of the technology industry workforce, respectively (Kaur 2020). A World Economic Forum Executive Opinion Survey covering 2018–2019 (see Figure 3) indicates the extent to which industry leaders believe women are entering information technology roles (across all sectors). Executives across all AMS surveyed correctly recognize that women are not entering information technology roles at a rate equal to that of men.

Figure 3: Women in Information Technology Roles (WEF 2021)



to which industry leaders believe women are entering information technology roles (across all sectors). Executives across all AMS surveyed correctly recognize that women are not entering information technology roles at a rate equal to that of men.

There are more women in Myanmar who hold ICT jobs than men; the opposite is true of Brunei Darussalam, Cambodia, the Philippines, Singapore, Thailand, and Vietnam, where up to 10 times

as many men hold ICT positions (ILO n.d.). It is not surprising that fewer women hold ICT jobs in several AMS, because as indicated above, they comprise a minority of ICT graduates in the seven AMS where data are available.

Globally, women comprise 26 percent data and artificial intelligence positions and 12 percent of cloud computing positions (WEF 2020).³ Singapore beats these global averages, with women holding 33 percent of data and artificial intelligence roles and 19 percent of cloud computing roles (WEF 2020). Notably, the emerging field of data and artificial intelligence is expected to have greater gender parity than more established fields such as cloud computing and engineering. Unlike other fields where skills development is an issue, there is a greater proportion of women with the relevant skills for data and artificial intelligence jobs globally than are women currently filling those roles, suggesting the under-utilization of women’s talent and the potential for greater gender parity with the right actions (WEF 2020).

³ Analysis draws on data from 20 countries: Argentina, Australia, Brazil, Canada, France, Germany, India, Ireland, Italy, Mexico, Netherlands, New Zealand, Saudi Arabia, Singapore, South Africa, Spain, Sweden, United Arab Emirates, United Kingdom, and United States.

Table 4: Annual Employment by Sex (thousands) (ILO n.d.)

ASEAN Member State	Year	Civil Engineering		Architectural & Engineering Activities; Technical Testing & Analysis	
		Male	Female	Male	Female
Brunei Darussalam	2020	8.2	0.4	1.3	0.8
Cambodia	2019	8.1	-	4.1	1.5
Indonesia	2015	587.9	22.0	66.4	22.9
Lao PDR	2017	4.8	1.8	0.9	0.1
Myanmar	2019	33.2	15.4	-	-
Philippines	2020	215.4	18.2	20.4	9.9
Singapore	2021	2.4	1.2	7.4	3.8
Thailand	2020	80.4	20.6	37.4	11.4
Viet Nam	2021	184.3	34.0	64.2	21.1

Women hold 15 percent of engineering jobs globally (WEF 2020). Women comprise 12 percent of automation engineers, 13 percent of Android developers, and 18 percent of robotics engineers globally (WEF 2020). There are fewer women civil engineers than men in eight AMS for which there are data (see Table 4). In the ASEAN region, men dominate civil engineering jobs, ranging from twice the number of women to 20.5 times the number of women. Similarly, there are fewer women employed in architectural and engineering activities, technical testing, and analysis than men; women hold between 10 percent and 38 percent of jobs in this field in eight AMS for which there is data (ILO n.d.).

Employment in STEM-Related Sectors

In seven AMS – Brunei Darussalam, Cambodia, Indonesia, Lao PDR, the Philippines, Singapore, and Vietnam – a woman who is not pregnant and not nursing can legally work in the mining, construction, manufacturing, energy, water, agriculture, or transportation industries in the same way as a man (World Bank 2022). In all AMS, women are underrepresented in the transport, storage, and communication sectors (ILO n.d.).

Global data from 2018 show that on average, there are 76 percent fewer women than men working in the energy sector (International Energy Agency 2022). Women represent 32 percent of the global renewable energy workforce, though just 28 percent of them work in STEM-related roles (International Renewable Energy Association 2019). Globally, women hold 22 percent of oil and gas industry jobs as of 2020 (Inenato et al. 2021). Although women are legally permitted to work in the energy sector in nine of ten AMS (with Malaysia being the exception), their employment rate remains low (World Bank 2022), and women’s employment in oil and gas in the Asia-Pacific region declined between 2017 and 2020 (Von Lonski et al. 2021).

WOMEN IN STEM LEADERSHIP

Leadership roles in STEM take many forms, including senior government officials and policymakers, c-suite executives and board members, entrepreneurs and founders, inventors and patent holders, and more. While women are underrepresented in all STEM leadership capacities in the ASEAN region, they generally fare well against global averages.

Women need to be proactively included in the policymaking process to ensure that policies, frameworks, and initiatives are inclusive and promote women’s participation in STEM. Further, having women in leadership roles in science and technology ministry roles can help set the tone for

an inclusive policy agenda that recognizes the need to foster women in STEM. However, most ministers and secretaries of science and technology in the ASEAN region are men. Women also remain underrepresented in roles carrying out STEM policies across all levels of government. For instance, as of 2017, women comprised 35 percent of permanent staff positions in the Ministry of Science and Technology of Lao PDR (UNESCO 2018b).

In Malaysia, women held 23.7 percent of board seats of life sciences and healthcare companies in 2021, which exceeded the global average of 21.3 percent that year. In technology, media, and communications companies, women held 7.8 percent of board seats in Indonesia, 20 percent of board seats in Malaysia, and 22 percent of board seats in Singapore in 2021 (Deloitte Global 2022). Women also remain underrepresented in executive positions. For instance, women comprise 14 percent of chief

Professional advancement and career development opportunities are critical to ensuring women can advance to leadership roles in the STEM workforce.

These opportunities can appear in a variety of ways, from skills building in leadership or technical areas such as coding, to networking and structured mentoring, to formal sponsorship and targeted coaching. However, a survey of technology companies in Southeast Asia found that executive coaching and professional development – including formal and informal mentoring, as well as formal sponsorship of individuals and individualized roadmaps for advancement – were not widely available (BCG 2020).

technology officer positions in Singapore and 12 percent in the other AMS. Notably, companies are also hiring women from Asia-Pacific offices into global roles based elsewhere (Coult 2020).

While women in ASEAN comprise a larger majority of the technology workforce than the global average, their participation is limited in leadership roles. For instance, only a small percentage of tech start-ups have female founders or co-founders in ASEAN (Half the Sky 2022). Just three of the ASEAN region’s approximately 30 unicorns – privately held startups with a valuation of over \$1 billion – are women-led (Tech Collective 2022). This may stem, in part, from the gender gap in start-up funding that is present both within ASEAN and globally. In 2019, emerging market companies with a woman on their founding team received just 11 percent of seed-funding capital and 5 percent of later-stage funding (Burns 2021). The gender gap in start-up funding may be accredited in part to the low presence of women investors, as well as wide-ranging gender biases that affect investment decisions. In a 2020 review of 34 venture firms active in Southeast Asia, only one-third had one or more female partners on their investment teams. Fortunately, there has been an increasing presence of female-focused incubators, accelerators, and venture capital funds to facilitate more investment and mentorship opportunities for women entrepreneurs and founders in Southeast Asia (Deloitte Southeast Asia Innovation Team 2021). Some examples include Her Capital, Indonesia Women Empowerment Fund, Patamar Capital’s Beacon Fund, and She Loves Tech.

Table 5: Women Inventors (World Intellectual Property Organization (WIPO) 2021)

ASEAN Member State	Share of Women Inventors
Indonesia	9.4%
Malaysia	26.7%
Philippines	37.7%
Singapore	15.5%
Thailand	26.3%
Vietnam	24.1%

In the six AMS where data are available (see Table 5), women comprise a minority of inventors. Of these AMS, four have a higher share of women inventors than the global average for 2021 (16.5 percent). A significant share of women also apply for a patent

alongside a team consisting of one or more men (though men are more likely to apply in a team than women). In Malaysia, 50.3 percent of patent applications include at least one woman inventor. In

2020, the top three fields for women’s patent applications globally were biotechnology, food chemistry, and pharmaceuticals; the least were filed in transport; engines, pumps and turbines; and mechanical elements. Patent applications by women are particularly low in fields related to engineering, including: civil engineering (18 percent); machine tools (18 percent); mechanical elements (16 percent); and engines, pumps and turbines (16 percent). This is consistent with the low participation of women in engineering education and employment.

Globally, patent parity is expected to be reached by 2053. According to WIPO, “The underrepresentation of women in international patenting and innovation is a loss of innovative potential” (2022). Further, increasing the number of women applying for patents may lead to greater job satisfaction and retention. Patents can also pave the way for longer careers and STEM leadership roles, particularly because patents are linked to promotion in technical fields (Tregillis et al. 2022).

Women also demonstrate leadership and hold senior positions within research. There is quite a range of representation of women in these roles across AMS. Women hold 5.7 percent of the highest research positions (typically director of research or full professor) in Brunei Darussalam, where representation of women decreases with seniority, in line with the global trend. Myanmar is the exception, where women hold 71.6 percent of the highest research positions (UNESCO 2018a). Globally, women researchers in STEM are also less likely than their male counterparts to publish their research. Women-authored publications are cited less often than men’s, which can discourage publishers from accepting women-authored papers for publication (Bello et al. 2021). One cause of this, demonstrated by research outside of the ASEAN region, may be bias in the publishing pipeline – including in the reviewing and editorial process (Fine and Shen 2018).

Career Insecurity

In the Asia Pacific, more women than men “...in the STEM workforce are at early or mid-career stages and are underrepresented at senior levels. Consequently, they are often more likely to be in precarious employment reliant on short-term grant funding and not yet in tenured or management research positions” (Australian Academy of Science 2021). When women are concentrated in less stable or short-term positions, their supervisors are less likely to invest in them through professional development and leadership opportunities and they are more likely to drop out of the STEM workforce.

Since publishing research in high-profile academic journals is often helpful or even required for attaining positions at the most prestigious universities, women are automatically at a disadvantage by being less likely to publish research than men. Women are underrepresented as faculty in STEM fields across ASEAN. For instance, a survey of computer science programs

at 17 top universities around the world found that women comprised only 16.1 percent of tenure-track faculty whose primary research focus area is artificial intelligence (Zhang et al. 2021). Additionally, women with disabilities are even less present in STEM faculty positions. Sources outside of ASEAN point to obstacles, including institutional constraints such as lack of support on accommodations and inflexible tenure tracks, as well as biases, such as the belief that women with disabilities are not competent (Disabilities, Opportunities, Internetworking, and Technology 2022). This dearth of women faculty members robs female students of having women as mentors and role models in academia (APEC 2016).

THE GENDER WAGE GAP IN STEM FIELDS

While the wage gaps differ for various types of occupations and sub-sectors, generally, women in STEM earn less than men across ASEAN. As shown in Table 6, the average monthly earnings by

women in the professional, scientific, and technical activities⁴ are lower than men, except in Myanmar (ILO n.d.).⁵ Although the pay gaps in professional, scientific, and technical activities range across AMS, women earn, on average, as little as 68 percent of men’s earnings.

Table 6: Average Monthly Earnings in US\$ of Employees in Professional, Scientific, and Technical Activities, Disaggregated by Sex (ILO n.d.)

AMS	Year	Value (US\$)	
		Male	Female
Brunei Darussalam	2014	\$2,214.31	\$1,840.24
Cambodia	2019	\$466.82	\$375.74
Lao PDR	2017	\$298.40	\$203.14
Malaysia	2020	\$1,110.27	\$799.81
Myanmar	2020	\$290.43	\$383.29
Philippines	2020	\$544.08	\$488.88
Singapore	2020	\$4,769.73	\$3,815.93
Thailand	2020	\$780.76	\$751.25
Vietnam	2021	\$422.08	\$371.81

The gender wage gap also exists in the information and communication sector, though in fewer AMS. The average monthly income of women working in the information and communications sector⁶ in Brunei Darussalam, Cambodia, and Lao PDR is higher than men. In Myanmar and the Philippines, women have nearly reached gender pay parity in this sector.

As noted in the previous section, women comprise a minority of patent holders. Closing the gender gap in patents could help close the gender wage gap. In technical fields, obtaining patents is often associated with wage increases and monetary incentives. Inventors with patents have higher incomes on average than those without patents (WEF 2022).

The gender wage gap in STEM may be related, in part, to the fact that the Philippines, Thailand, and Vietnam are the only countries in ASEAN to legally mandate equal remuneration for work of equal value (World Bank 2022). However, most AMS – namely Cambodia, Indonesia, Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Vietnam – have ratified the ILO’s Equal Remuneration Convention, 1951 (No. 100), which asserts the principle of equal remuneration for men and women workers for work of equal value (International Labor Office 1951).

⁴ Includes: legal and accounting activities; activities of head offices; management consultancy activities; architectural and engineering activities; technical testing and analysis; scientific research and development; advertising and market research; other professional, scientific and technical activities; and veterinary activities.

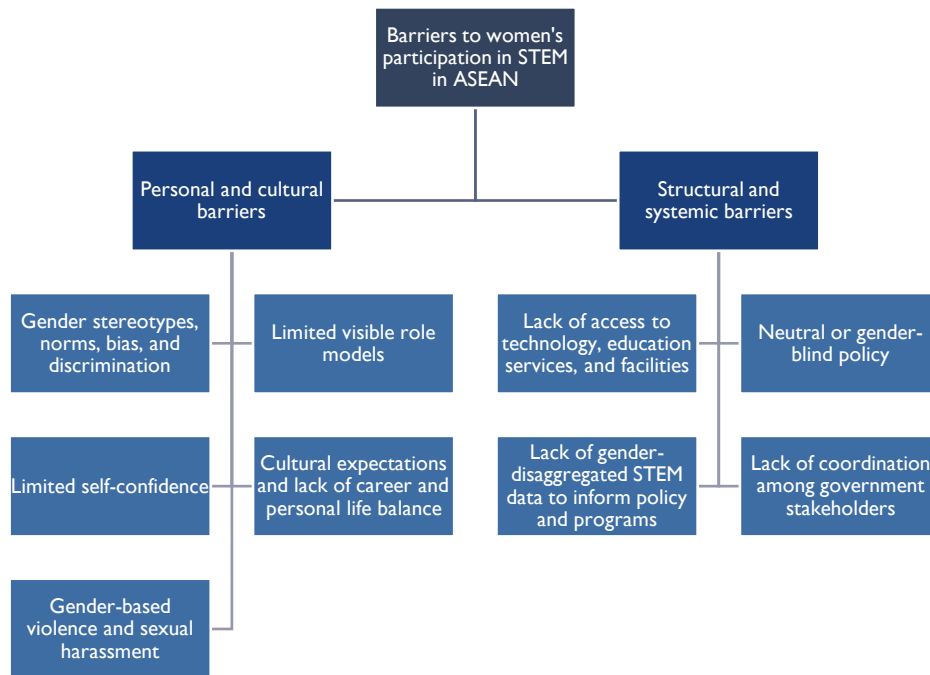
⁵ Excludes Indonesia as data is unavailable.

⁶ Includes: publishing activities; motion picture, video, and television program production; sound recording and music publishing activities; programming and broadcasting activities; telecommunications; computer programming, consultancy, and related activities; information service activities.

III. BARRIERS TO WOMEN'S PARTICIPATION IN STEM IN ASEAN

The gender gap in STEM education, employment, leadership, and earnings in the ASEAN region points to a number of remaining challenges that can be categorized by personal and cultural barriers and structural and systemic barriers. Many of these are mutually reinforcing and intertwined. Further, women and girls who come from disadvantaged backgrounds and/or minority groups may experience multiple, overlapping barriers that further hinder their participation in STEM.

Figure 4: Barriers to Women's Participation in STEM in ASEAN



PERSONAL AND CULTURAL BARRIERS

Gender stereotypes, norms, bias, and discrimination. Parents, teachers, and counselors may unintentionally limit girls' exposure to STEM and foster self-selection bias whereby girls decide that they should not pursue STEM (UNESCO Office Bangkok and Korean Women's Development Institute 2015). Many teachers perpetuate gender norms in school by discriminating against girls due to gender stereotypes (Clarke and Sawyer 2014). For instance, a study of teachers in Vietnam showed that they interact with boys, on average, nearly twice as much as with girls in mathematics and science courses (UNESCO Office Bangkok and Korean Women's Development Institute 2015). Not all teachers understand what STEM education is and many hold a bias against girls when asked about the suitability of STEM careers for their students (UNESCO 2020a). Girls with disabilities often face an added layer of stigma in STEM education (UNICEF and International Telecommunication Union 2020). Bias and stereotypes can also be held by women and girls themselves as a result of social and cultural norms.

The often-unintentional discouragement or limiting of exposure of STEM to young girls can affect them for their entire lives, even beyond their education choices. If women do not have an opportunity to discover an interest or passion in STEM subjects, they may not start a business or enter a career in those areas. This does not bode well for the representation of women as STEM business founders, as it is widely shown that women start businesses that they are interested in. In the workplace, cultural norms and resulting familial expectations around these norms may restrict women's career opportunities in STEM, such as occupations that require travel for long periods of

time away from family (Asia Foundation and Asian Development Bank 2020). Bias and discrimination can reduce women's chances of being hired, undermine their accomplishments, inhibit their ability to access professional development and skill-building opportunities, and reduce their chances of being promoted. While it is difficult to eliminate discrimination entirely, six AMS – Cambodia, Indonesia, Lao PDR, the Philippines, Thailand, and Vietnam – legally prohibit discrimination in employment based on gender (World Bank 2022).

Limited visible role models in STEM education and careers. Many girls and women lack role models in their community to pursue STEM learning and careers. There are fewer female teachers in STEM-related subjects than other subjects (UNESCO Office Bangkok and Korean Women's Development Institute 2015). This is important because female teachers have been found to positively influence girls' aspirations toward STEM careers (UNESCO 2017). There are also fewer women role models in STEM careers than men. The lack of visibility of women role models inhibits women and girls from visualizing themselves in STEM careers and can negatively affect women's ability to access and benefit from coaching, mentoring, and networking opportunities.

Limited self-confidence. Lack of confidence inhibits women and girls from pursuing STEM education, applying for STEM jobs, starting or seeking funding for a business in the STEM sector, and pursuing STEM leadership positions. One of the impacts of gender norms and negative stereotyping is that many women may lack self-confidence to pursue their studies and a career in STEM. Even when girls do not agree with gender stereotypes about boys being better at math and science, simply understanding that people around them believe these stereotypes to be true undermines girls' confidence. Female peers can also influence girls' confidence in mathematics and science (UNESCO 2017). When girls lack confidence in STEM subjects, they are less likely to continue studying the subject.

Quotas can often be a critical and positive policy measure to enhance women's representation and mitigate barriers such as bias and discrimination. However, sometimes quotas on women in the workforce or in leadership positions can adversely affect the confidence of women in those positions, especially when male peers are aware of and remind colleagues of the quotas. The underlying message that women are present in STEM positions not because they earned it, but because they are meeting a quota, reduces their confidence and further fuels attrition (Bocuzzi and Uniacke 2021). Further, global research demonstrates that women are more likely to have a fear of failure in starting a business (and are given less space to fail), which is one factor that contributes to the large gender gap in tech start-up founders.

Cultural expectations and lack of support in balancing career and personal life.

Insufficient family leave and childcare policies, inflexible work schedules, and cultural biases against working mothers impact women's entry, retention, and advancement in all careers, including STEM. Limited childcare options and familial expectations, exacerbated by the COVID-19 pandemic, impact women's ability to engage in skills building or professional development activities that would help lead to leadership opportunities. Flexible work arrangements, perceived to be more common after the onset of the COVID-19 pandemic, are critical to helping women juggle the demands of work and family. However, just 56 percent of women in STEM careers in the Asia-Pacific region who have caring responsibilities have access to flexible work arrangements (Australian Academy of Science 2021). Inaccurate stereotypes – including that women who are mothers are less committed to their work – lead to biases of employers that can keep women from obtaining jobs or being promoted.

Gender-based violence (GBV) and sexual harassment. Particularly common in male-dominated disciplines including STEM, women are adversely impacted by gender-based violence and

sexual harassment, which creates a hostile environment and inhibits them from achieving their full potential in school and the workplace. Global evidence points to GBV in education as a limitation to girls' ability to learn and a contributing factor to girls dropping out of school (Cohen et al. 2018). As of 2018, the Philippines was the only AMS to legally protect against sexual harassment in education (World Bank 2018).

GBV and sexual harassment in the workplace are widespread within ASEAN and globally. Women who experience sexual harassment in the workplace are less productive, absent more frequently, and more prone to resign. In addition to disproportionately impacting women, workplace sexual harassment has negative effects on coworkers and economic productivity (Cohen et al. 2018). Seven AMS – Cambodia, Lao PDR, Malaysia, the Philippines, Singapore, Thailand, and Vietnam – have laws protecting against sexual harassment in the workplace (World Bank 2022). While legal protections cannot entirely eradicate sexual harassment alone nor entirely, such legislation is critical not only for women employees, but also as women business owners. Globally, women are more likely to have majority ownership in firms in countries that legally protect against sexual harassment in the workplace (World Bank 2018).

STRUCTURAL AND SYSTEMIC BARRIERS

Lack of access to technology, education services and facilities. Women and girls lack the same opportunities as men and boys to access basic technology and education services. Across Indonesia, Malaysia, and Singapore, women's access to the internet is on average 4 percent lower than men while mobile phone ownership is 4–14 percent lower than men (The Sasakawa Peace Foundation and Dalberg Global Development Advisors 2017). The gender digital divide is even more acute in rural areas and traditional and conservative families. Access to technology also influences the capacity to access information and resources. Lower access to technology hinders girls' interest in pursuing digital technology skills, stifles independent exploration and development of online skills, and interferes with their ability to recognize the full potential of ICT. The gender digital divide ultimately negatively impacts women's chances of entering careers in STEM. Further, the majority of women entrepreneurs and owners of micro, small, and medium-sized enterprises (MSMEs) have more limited use of digital tools than men (Economic Research Institute for ASEAN and East Asia 2019). This gender gap inhibits women business owners from digitalizing their businesses, which is ever more critical since the onset of the COVID-19 pandemic.

Neutral or gender-blind policy. Government policies are mostly gender-neutral without consideration and analysis of the social inclusion context. Many policies in the region (and globally) do not specifically recognize social and gender gaps, exclude the consideration of gender and social inclusion analysis, and therefore exclude interventions to address the gaps. For instance, not all national science policies highlight women and girls as a priority, and not all national gender policies call out STEM as a priority sector. Most that do so focus on women's participation in STEM education but not in the workforce. Current efforts including policies to promote STEM are expanded upon in the following section.

Lack of comprehensive gender-disaggregated data in the STEM sector to inform policy and program development. Achieving gender equality and a more prosperous ASEAN necessitates quality data on women and girls. Such data are critical to decision-making and developing evidence-informed and equitable policies and programs that drive inclusive economies. There is a strong foundation of comparable national-level gender-disaggregated data in a few areas pertaining to STEM, including STEM education (test scores, degrees) and participation of women in research positions and particular fields within STEM (collected by UNESCO). However, some of the

data do not cover all AMS and more gender-disaggregated data are needed on women in leadership roles within STEM. Further, gender-disaggregated data in the STEM sector lack an intersectional approach to data collection. For instance, data in ILOSTAT (the ILO statistical database) that disaggregate by sex and relevant STEM industries do not disaggregate by location (rural/urban), disability, or age. Data disaggregated by multiple layers of identity is critical for crafting tailored policies and programs that meet the needs of *all* women.

Lack of coordination among government stakeholders. All AMS governments have established institutional organizations to address gender equality and women's empowerment issues. However, efforts to promote women in STEM require involvement of various stakeholders; the ineffective coordination among stakeholders creates challenges for implementing government policies and programs. Coordination among government institutions is not easy because awareness of gender issues is generally low and therefore further socialization is required.

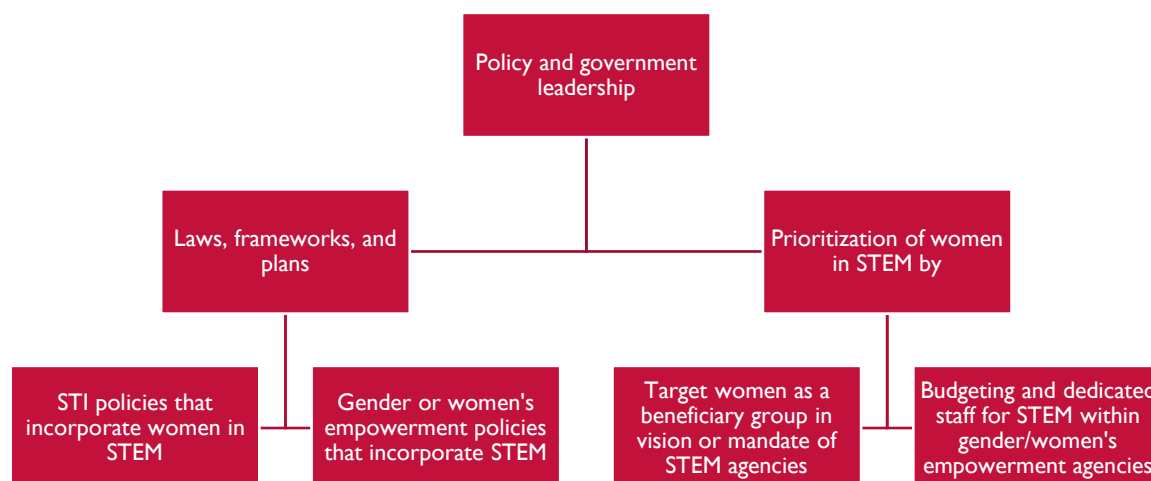
IV. EFFORTS TO SUPPORT WOMEN'S PARTICIPATION IN STEM IN THE ASEAN REGION

Governments in the ASEAN region have displayed considerable commitment to supporting women in STEM education and careers through national laws, policies, frameworks, and plans, as well as reinforcing programs and initiatives. There are a number of strong examples of successful national-level policies and programs that have paved the way to a better future for women in STEM.

POLICY AND GOVERNMENT LEADERSHIP

Countries outside of ASEAN have implemented specific policies aimed at promoting women in STEM, such as the Republic of Korea's *Act on Fostering and Supporting Women Scientists and Technicians*. While ASEAN has not followed suit (yet), AMS should be commended for mainstreaming a commitment to support women in STEM through other policies and frameworks.

Figure 5: Types of Policy and Government Leadership Supporting Women in STEM



Some AMS' national science policies highlight women and girls as a priority, including gender-related education targets and policy measures on women's participation in STI careers. Examples include:

- Cambodia's *Science, Technology, and Innovation Roadmap 2030* calls for women to make up at least 40 percent of STEM graduates by 2030 (Kingdom of Cambodia 2021).
- The *Fourth-Five Year National Plan of Action on Gender Equality (2021–2025)* of Lao PDR calls for 4,000 university graduates in natural science, engineering, and technology, with 35 percent women. It also calls for teaching methods that take into account gender equality for teachers of science, technology, engineering, and mathematics in secondary education and higher education (National Commission for the Advancement of Women, Mothers, and Children 2021).
- Malaysia's *National Policy for Science, Technology and Innovation (NPSTI) 2021–2030* includes initiatives to increase women's participation in the STI workforce and encourage re-entry of women into the workforce under its strategy to expand STI talent participation in the workforce (Ministry of Science, Technology, and Innovation 2021).
- Vietnam's *Law No. 29/2013/QH13 on Science and Technology* encourages "training and employment of female resources in science and technology with priority given to attraction

and training for human resources in the areas facing extreme socio-economic difficulties” (National Assembly 2013).

Several AMS have strong gender equality and women’s empowerment laws, strategies, plans, and policies, that specifically call for women’s participation in science and technology. Examples include:

- Lao PDR’s *Law on Gender Equality, No.77/NA* which includes a chapter on science, information, technology, and environment (National Assembly, Lao PDR 2012).
- The *Women Development Action Plan* of Malaysia includes actions to be taken by the government agencies, nongovernmental organizations, the private sector, and civil society to achieve the objective and the mission of the National Women’s Policy and covers 13 sectors, including science and technology (Department of Women’s Development 2022).
- The Philippines’ *Updated Gender Equality and Women’s Empowerment Plan 2019–2025* includes strategic goal area on expanded opportunities for women’s participation, leadership and benefits in science, technology and innovation, ICT, infrastructure, and energy, including a chapter on science, technology and innovation and ICT (Philippine Commission on Women 2022).
- The *Philippine Plan for Gender-Responsive Development 1995–2025* includes a chapter on science and technology, which includes a subsection on women as workers in the science and technology sector that touches on education and leadership, among other issues (Philippine Commission on Women 1998).

Finally, efforts to support women in STEM are also embedded in mandates, visions, and priorities of national ministries and agencies. For instance, the Malaysia Innovation Foundation, supported by the Malaysian government, targets women as a beneficiary group in its founding vision (UN Women 2021). Additionally, there is a Sub-Deputy of Gender in Science and Technology under the Women Empowerment and Child Protection Ministry of Indonesia which is responsible for policy, implementation, and budgeting on gender in science and technology including gender data in science and technology (Ministry of Women’s Empowerment and Child Protection 2010).

While there are strong and tangible examples of policies to promote women in STEM education and careers in the ASEAN region, there is a need to ensure these policies are translated into practice through meaningful investment, implementation, and monitoring and evaluation measures. Further, policy implementation is complemented by numerous programs and initiatives, which are expanded upon below.

PROGRAMS AND INITIATIVES

Governments in the ASEAN region have led pioneering women in STEM programs – including skills-building camps and programs, networks and mentoring, and competitions and contests, among others. While initiatives cover many aspects of STEM, women and/or girls in tech programs are a common focus throughout AMS. Less common are programs on mathematics and engineering.

Skills development programs are amongst the most common types of women in STEM interventions. They often cover technical skills for women and girls, including programming (including coding), computer literacy, and robotics. Skills development programs also focus on soft skills such as creative thinking, critical thinking, self-organization, interpersonal communication, public speaking, and leadership.

Networks and professional organizations are also one of the more prevalent types of support mechanisms for women in STEM. Networks are organized at both the national and local levels and

focus either on STEM or a specific field of STEM (such as engineering). Networks offer a space for women to exchange learning, build confidence, encourage peers, find role models, and identify mentorship and sponsorship opportunities. Most networks are nonprofits independent from the government but may receive some government funding either from the national government or a foreign donor. Mentoring programs are often linked to networks, professional organizations, or skills development programs or bootcamps. Mentorship not only provides another way for women and girls studying STEM to access STEM related fields, but also assists schools in improving their curricula to match the needs of STEM employers (ILO 2021).

Competitions and contests can offer opportunities for women in STEM to showcase their work and research, network with other women in the field, and obtain awards to further their work or research. They also serve as critical awareness-raising activities, as they raise the profile of successful women in STEM, creating role models for women and girls. Examples include women in STEM or science competitions, start-up pitch competitions, and hackathons.

The following are select, more detailed illustrative examples (neither exhaustive nor representative) of successful and promising programs and initiatives at the regional and national levels to support women's participation in STEM. The examples come from various types of entities including government, private sector, nongovernmental organizations, academia, and international organizations, as policymakers can learn from a wide range of promising approaches taken by a variety of stakeholders.

Initiative Name	AMS	Sector(s)	Focus	Description
Women in Science Competition	Brunei Darussalam	Private	Women in STEM education	Organized by Seria Energy Lab starting in 2019, this competition crowns a young woman (age 13–17 years old) in science. The competition aims to equip young women of Brunei Darussalam to face current global challenges and to enhance their skills in leadership, project management and innovation (Seria Energy Lab 2020).
Technovation Cambodia	Cambodia	Government and academia	Technology entrepreneurship for girls	Technovation Cambodia is a 12-week tech entrepreneurship program for girls aged 8 to 18 organized by Tech for Kids Academy and the Ministry of Education, Youth, and Sport. The Ministry of Economy and Finance and the Union of Youth Federations of Cambodia's (UYFC) Technology and Innovative Youth initiative also sponsor the program. The program focuses on STEM education app building and Artificial Intelligence technology to promote tech and entrepreneurship to girls and concludes with a pitch competition (Simala 2022).
SheHacks	Indonesia	Private	Technology skills building	Indonesian telecommunications company Indosat Ooredoo Hutchison's SheHacks program aims to reduce gender gaps by empowering women and girls in technology use. Since its launch in 2020, the program has empowered more than 1,500 women in Indonesia. In 2022, SheHacks expanded to include mentoring, incubators, and bootcamps (Onlinejambi.com 2022).
Second Strengthening Higher Education (SSHEP II) Project	Lao PDR	Multilateral organizations	Higher education	Implemented by the Asian Development Bank, the SSHEP II Project aimed to improve the higher education system and technical and vocational education and training programs to deliver graduates with job-ready skills. Through grant and loan assistance, the project enhanced women's leadership skills and professional expertise of women educators, as well as increased enrollment rates of female students in STEM subjects (ADB 2016).
Institution of Engineers Malaysia (IEM), Women Engineers Section	Malaysia	Nonprofit	Engineering	The Women Engineers Section of IEM was established to connect women in engineering careers and to create alliances among engineering professional bodies to inspire, support and celebrate women engineers in their career development. The Women Engineers Section has six chapters in Malaysia: Southern, Perak, Penang, Miri, Pahang and Sabah. It conducts outreach to university students, raises awareness of engineering as possible career in schools, holds a gender equality essay contest, hosts webinars on women engineers in

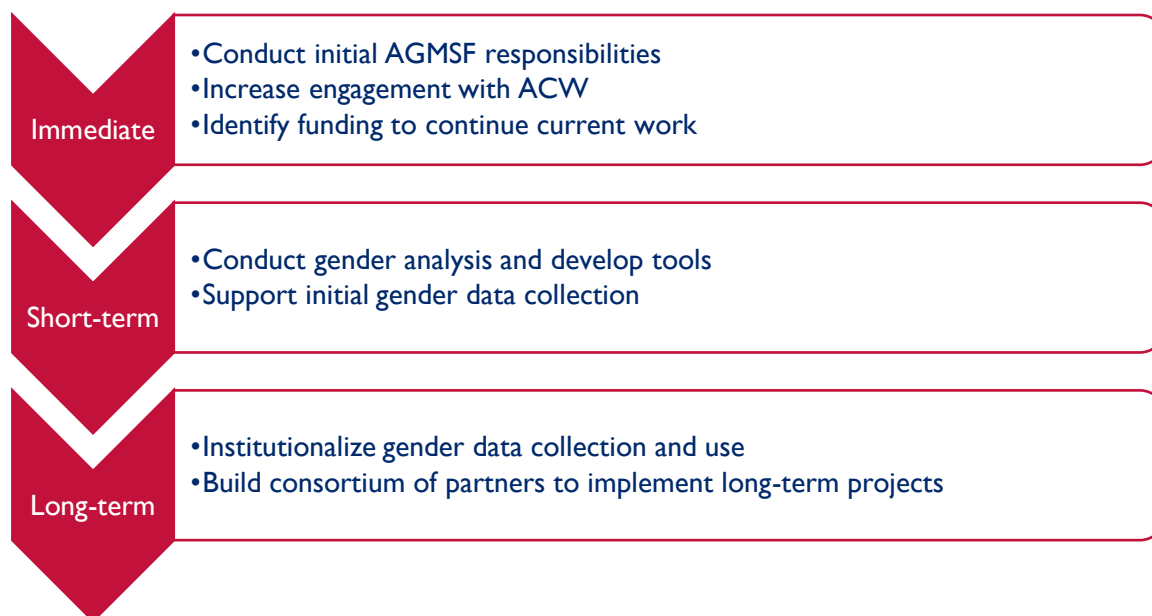
Initiative Name	AMS	Sector(s)	Focus	Description
				leadership, and hosts national and international conferences to convene women engineers from within and outside of Malaysia.
Geek Girls Myanmar	Myanmar	Nonprofit	Women in tech	The organization focuses on women in the ICT industry, improving women's access to technology, and closing the gender digital divide. It hosts tea talks, roundtable discussions, webinars, and workshops on topics including leadership, female founders, cyberbullying, and digital literacy, amongst others. It also has an online community group where women and girls can exchange knowledge on technology and more (Geek Girls Myanmar n.d.).
Women-Helping-Women: Innovating Social Enterprises (WHWise) Program	Philippines	Government	Access to technology and research and development support for women founders	The WHWise Program of the Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) supports women-owned social enterprises that need greater access to technology, early-stage funding, and tailored support. Participating women receive up to Php 5 million, coupled with incubation, mentoring, research and development assistance, capacity building, and more (PCIEERD 2022).
Promotion of Women in Engineering, Research, and Science (POWERS)	Singapore	Government and academia	Transitioning women from education to STEM careers	Nanyang Technological University (NTU), Singapore, in collaboration with Ministry of Education of Singapore, aims to increase gender diversity in STEM careers through the POWERS program. The program recruits and empowers women by creating a supportive ecosystem, doing research to address barriers, and providing education and skills building opportunities for career advancement in STEM. The program is supported by Women@NTU, a voluntary initiative (NTU Singapore 2021).
STEM Training Program	Thailand	Government and multilateral organizations	Training and women in STEM data	In 2019, the Ministry of Labor, in collaboration with the ILO and UNESCO, developed a STEM training program for entry-level women workers with low STEM skills in the electronics sector. The training enhanced knowledge, competencies, and skills needed to collect, analyze, and present manufacturing-related data for decision-making. This served as a pilot for a policy toolkit under UNESCO's global STEM and Advancement program that aimed to analyze the impact of policies on gender disparities in STEM, improve indicators for evidence-based policy, and build capacity to collect data on gender in STEM (Royal Thai Embassy, Washington, DC 2017).

Initiative Name	AMS	Sector(s)	Focus	Description
SHINE	Vietnam	Private	Women tech start-up founders	SHINE is an incubation program aimed at women founders of early-stage startups. It provides 12 weeks of training and mentorship. Through the program, women develop a startup playbook to help them grow their businesses. SHINE is run by Ascend Vietnam Ventures, an early-stage venture capital fund that supports tech entrepreneurs in Vietnam (Coach Dris n.d.).
Underwriters Laboratories-ASEAN-U.S. Science Prize for Women	Regional	Public-private partnership	Science and research	The United States government, in partnership with ASEAN and Underwriters Laboratories, aims to strengthen ASEAN science and technology capacity and gender equality through this annual prize competition. The competition provides promising, ASEAN-national, mid-career and senior female scientists with recognition awards for their academic and professional achievements. It emphasizes female scientists who have used their work to improve society in sustainable ways and have acted as role models for other women learning, working in, and pursuing careers in STEM.
Asia and Pacific Nation Network, International Network of Women in Engineering and Sciences	Regional	Nonprofit	Science and engineering	This network aims to strengthen the participation of women and girls in all aspects of STEM in Asian and Pacific nations. Through meetings, a network, and promoting the role of women scientists and engineers in the region, this network works to build capacity of individuals, organizations, and businesses to effect policies in STEM globally, and to encourage the education, recruitment, retention, support, and advancement of women and girls. It conducts exchange and visiting programs as well as empowerment and education programs, among other activities.
APEC – Australia Women in Research Fellowship	Regional	Government	Researchers in STEM	This fellowship program, an APEC project by the Australian Government Department of Education, Skills and Employment, aims to enhance the careers of women researchers in STEM, and support mobility and research collaboration. Women researchers from developing economies are selected for a fellowship at an Australian research institution for a one-to-four-month period.

V. RECOMMENDATIONS TO ADVANCE WOMEN IN STEM

The following actionable policy recommendations are intended to provide the ASEAN Committee on Science, Technology, and Innovation (COSTI) and relevant stakeholders with considerations and recommendations to enhance women’s participation and address gender gaps in STEM at the regional level. The recommendations include a variety of types of actions over the immediate, short, and long term. Immediate actions are to be implemented within the next twelve months. Short-term actions are envisioned to be implemented within one to three years during the implementation of the APASTI 2016–2025, while long-term actions are to be implemented after three years during the implementation of the APASTI 2026-2035.

Figure 6: Summary of Recommendations



IMMEDIATE ACTIONS

1. Review and realize COSTI’s opportunities and responsibilities under the ASEAN Gender Mainstreaming Strategic Framework 2021–2025 (ASEAN 2021), including through a sensitization and socialization workshop;
2. Establish a STEM Gender Focal Point for all 10 AMS (in line with the implementation of ASEAN Gender Mainstreaming Strategic Framework);
3. Engage with the ASEAN Committee on Women (ACW) periodically to exchange information and perspectives on gender equality and women’s empowerment issues in the STEM sector and ensure coordination on initiatives relevant to both committees; and
4. Identify public-private partnerships and funding mechanisms to sustain COSTI’s current initiatives that support women in STEM, such as the Underwriters Laboratories-ASEAN-U.S. Science Prize for Women.

SHORT TERM ACTIONS

1. Conduct a mapping of gender dimensions in science, technology, and innovation (STI) international cooperation agreements (including bilateral and multilateral agreements, and

memoranda of understanding), using a survey on gender equality implementation in STI agreements and qualitative interviews with relevant stakeholders AMS and Dialogue Partners;

2. Conduct an in-depth gender equality and social inclusion (GESI) analysis of STI to inform the development of the next APASTI and to identify the key GESI issues within STI that COSTI will focus on;
3. Tailor the UNESCO STEM and Gender Advancement (SAGA) tools⁷ to the ASEAN region, for use by policymakers to reduce the current gender gap in STEM fields in education and research; and
4. Support the ASEAN University Network (AUN) to gather gender-disaggregated data about the representation and experiences of women in science and technology fields at the university level, harnessing women researchers (particularly those in the early stage of their career).

LONG TERM ACTIONS

1. Build or integrate gender-disaggregated data in the ASEAN STI data system that may be used to inform future programming, initiatives, and strategies; and
2. Build a core consortium of strategic partners – from the private sector, non-profits, and academia – to partner in implementation of long-term initiatives that meaningfully address gender gaps and enhance women’s participation and leadership in STI.

⁷ <https://en.unesco.org/saga>

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