OVERVIEW

Engendering Access to STEM Education and Careers in South Asia

Shobhana Sosale, Graham Mark Harrison,
Namrata Tognatta, Shiro Nakata, and Priyal Mukesh Gala

WORLD BANK GROUP

SOUTH ASIA DEVELOPMENT FORUM

Overview

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Overview

Introduction

Globally, about 80 percent of men and more than half of women are in the workforce. Countries with larger shares of workers trained in science, technology, engineering, and mathematics (STEM) grow faster and advance more quickly, enabling opportunities for and benefiting all members of society. Countries that invest in STEM education and skills expand talents that contribute to social, economic, and technological advancements, facilitating growth and supporting progress toward the Sustainable Development Goals.

STEM investments also pay rich dividends to countries at every stage of development. For South Asian countries—Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka—a foundation of development is the enhancement of the education and skills of girls and boys and the expansion of STEM opportunities for women and men entering the workforce.

For many reasons, policy makers should care about STEM education for girls and women. Societies that understand STEM-related topics—such as climate change, clean water, and sustainability—are better able to respond to global challenges. Inclusive economic growth makes countries more likely to achieve the Sustainable Development Goals. To realize their potential, countries must make available and pursue opportunities for as many of their people as possible, and governments and their development partners should strengthen STEM education and advance women's participation in the workforce. It is also imperative, however, that STEM stakeholders—a diverse group from the public and private sectors—build a culture of inclusion and diversity to foster women's advancement in STEM.

STEM skills and experiences, coupled with a diversity of perspectives, are integral to building South Asia's STEM workforce in research and in developing new products and ideas. Thus, inclusion and diversity must be championed by governments and by STEM stakeholders that stand to benefit from more diverse workforces. Though women themselves would likely be credible champions, in South Asia they are often constrained by a range of factors. This report addresses those factors.

Focus and Goals of This Report

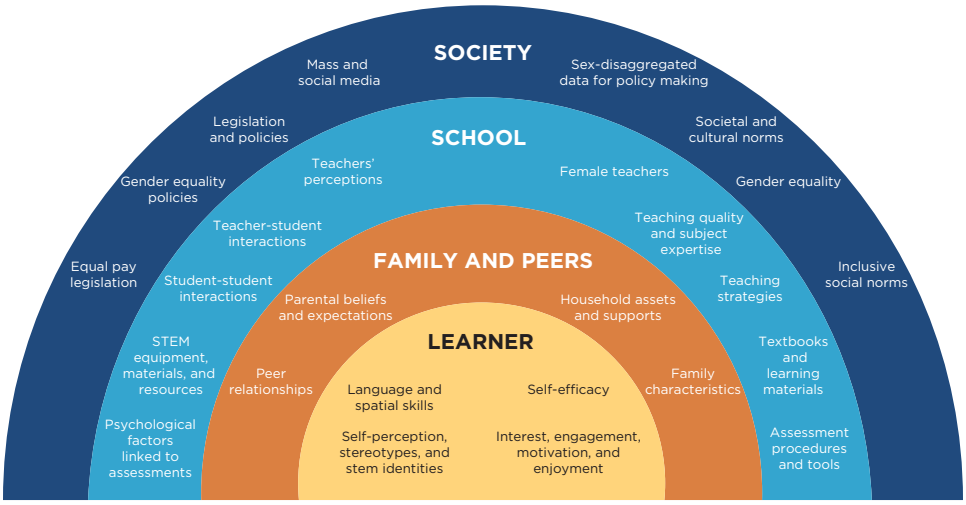
This report aims to improve understanding of the barriers to and ultimately to address the gender segregation in access to and participation in STEM in South Asia. To that end, it applies a hybrid multidimensional framework to help explain the motivations for access to STEM education (figure O.1). This framework is used to assess how South Asian countries fare on access to STEM education, identify gaps, and offer recommendations for how access challenges can be addressed. Of note are the multidimensional elements and influencers:

- The key elements affecting *learners* are language and spatial skills, self-efficacy, self-perception, stereotypes and STEM identities, interest, engagement, motivation, and enjoyment.
- The role of *family and peers* involves peer relations, parental beliefs and expectations, household assets and support, and family characteristics.
- The role of *schools* combines psychological factors linked to assessments; STEM equipment, materials, and resources; student-student interactions; teacher-student interactions; teachers' perceptions; female teachers; teaching quality and subject expertise; teaching strategies; textbooks and learning materials; and assessment procedures and tools.
- The role of *society* combines equal pay legislation, gender equality policies, legislation and policies, mass and social media, sex-disaggregated data for policy making, societal and cultural norms, and inclusive gender norms.

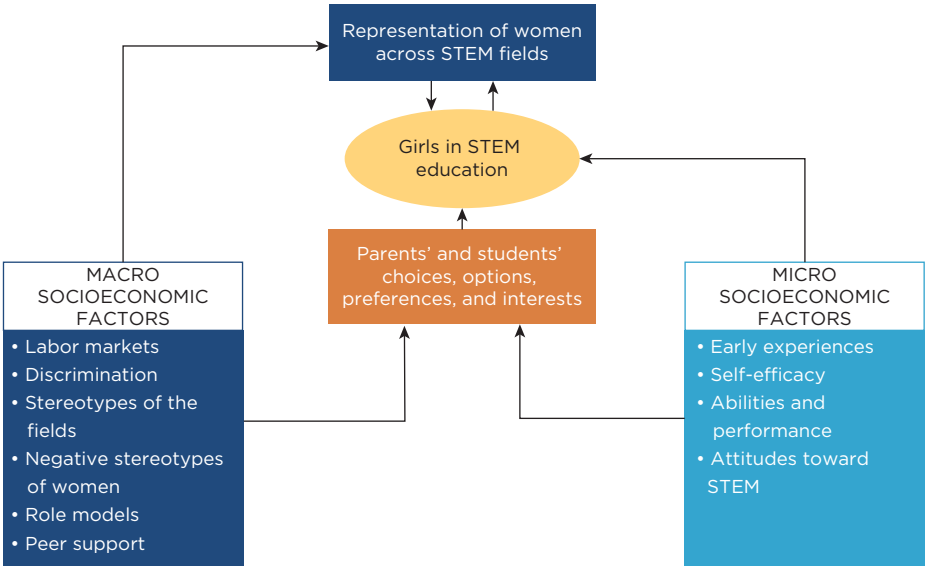
The methodology first considers the participation and performance of females in STEM subjects in primary, secondary, and tertiary education, including technical and vocational education and training (TVET). Female participation in the labor force is then reviewed, with a focus on STEM careers. The framework and a situational analysis of access to STEM education in South Asia are summarized. It is envisaged that applying the multidimensional framework and status analysis will help initiate dialogue within and among South Asian countries to explore areas for collaboration and potential investments in this important area.

FIGURE O.1 A Multidimensional Framework for Increasing Access to STEM Education and Careers in South Asia

a. Ecological framework of factors influencing girls' and women's participation, achievement, and progression in STEM studies



b. Macro and micro socioeconomic framework of factors influencing girls' and women's participation, achievement, and progression in STEM studies



Sources: Panel a, UNESCO 2017; panel b, adapted from NYAS 2016.
Note: Key aspects applicable to South Asia—gender stereotyping, absence of role models, and lack of trained teachers—apply to secondary education, technical and vocational education and training, and higher education. STEM = science, technology, engineering, and mathematics.

The report also highlights growth in STEM sectors as part of the transition to green economies and identifies options for improving the representation of women in these sectors. The World Bank proposes that countries follow six "adaptation pillars" to build resilience to climate change (World Bank 2022). Four are directly relevant to STEM education:

- *Pillar 1*: Ensure development is rapid, inclusive, and offers protection against shocks
- *Pillar 2*: Facilitate the adaptation of firms and people
- *Pillar 3*: Adapt land use and protect critical public assets and services
- *Pillar 4*: Help firms and people cope with and recover from disasters and shocks
- *Pillar 5*: Anticipate and manage macroeconomic and fiscal risks
- *Pillar 6*: Prioritize, implement, and monitor interventions.

Increasing access to education and opportunities for girls and women is among the most critical issues to consider in advancing the Sustainable Development Goals. Education and opportunities are essential foundations on which countries can strengthen society and address other challenges identified by the goals, including good health and well-being and decent work and economic growth.

Interventions can be tailored to local audiences and circumstances and to individual firms, nonprofits, nongovernmental organizations, and governments. Regardless of the types of STEM stakeholders, the education of students and the imparting of skills to them—and the STEM opportunities made available to women and men entering the workforce—are crucial.

This report recognizes the importance of health care workers. Its focus, however, is on other STEM professions—such as science, research, engineering, and information technology—in which women are underrepresented. The report delves into the performance and records of countries in South Asia. Within the region there are success stories as well as some common and some specific challenges. Based on available data on STEM participation in the region, the report draws conclusions and offers recommendations for actions that might encourage more girls and women in South Asia to pursue STEM education and careers—while at the same time strengthening societies.

Education's Evolution—and Stagnation

Around the world, significant advances have been made in increasing access to education. Yet many challenges remain, at all levels of education systems, in offering quality education to all children and imparting the skills needed. To fully benefit from the advances that STEM can bring about, all of society must be represented. Diversity in genders, backgrounds, perspectives, and countries of origin is a strength in STEM and

in the concepts, ideas, products, and solutions that scientific and technological knowledge deliver to society. Yet globally, including in South Asia, the following apply:

- Girls—especially poorer, rural ones—are underrepresented in science programs in secondary schools.
- Young women are not engaged in most TVET programs and in most STEM disciplines in tertiary education.
- A lower share of female STEM graduates work in STEM jobs.
- Women often do not hold senior positions in STEM industries.

Girls and women lose their potential for STEM talent in education systems and labor markets if they are not nurtured in STEM subjects from a young age. Primary and secondary education must provide the foundations for children to participate in and contribute to society. A critical component of that education is STEM, where girls' participation and continuation rates fall with age and education in South Asia and around the world. This "leaky pipeline" results in girls and women becoming increasingly disengaged from STEM in secondary and postsecondary education—and ultimately in jobs and careers. As a result, there is less diversity in the perspectives and insights that drive technical progress and economic development.

In South Asia, the main leaks in the pipeline for females occur as a result of the following:

- *Not enrolling in science in upper secondary education.* It is here that the STEM gender gap becomes evident.
- *Not entering STEM programs in postsecondary education.* About three-quarters of STEM students are male. Among the remaining quarter, 70 percent of female undergraduate STEM students are in health sciences.
- *Not joining the workforce.* In many South Asian countries women's labor force participation is much lower than men's. Moreover, educated women are more likely to be unemployed.

Participation in Education by Girls and Women in South Asia

South Asian girls and women face challenges in pursuing STEM at all levels of education. Though the region has made great advances in enrollment, secondary enrollment and learning achievement lag behind those of leading economies. And by the time children reach upper secondary education, male and female students have different perceptions of STEM careers.

The transition to upper secondary school might be the biggest indicator of the gender gap in STEM. Though this transition might not reflect the different attitudes toward

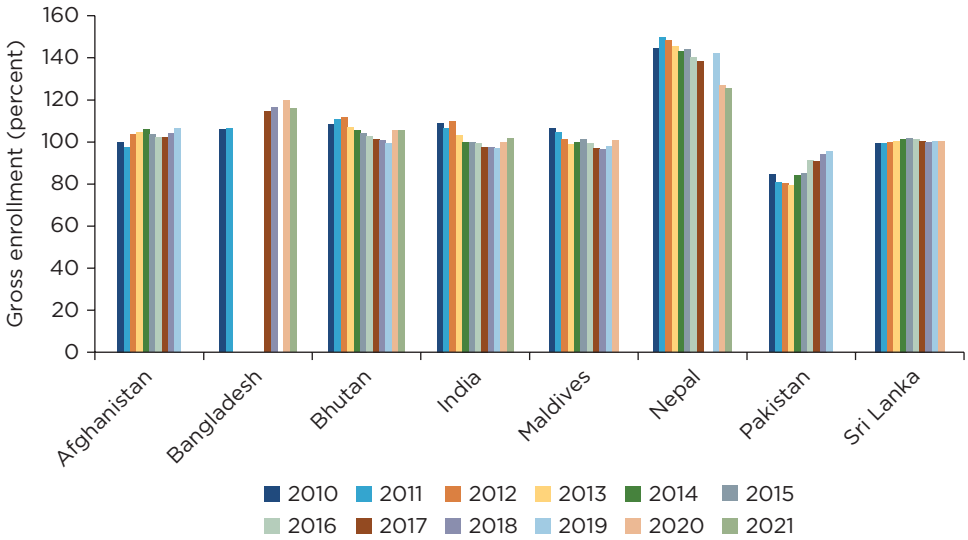
STEM among boys and girls—and their parents—specific tracks for STEM, arts, and commerce become available only at this point. Thus the data clearly show the point at which girls become underrepresented in STEM subjects. Accordingly, this demarcation point is not when interventions should be targeted because attitudes are already set. Instead, STEM education interventions need to happen much earlier, in primary education.

PRIMARY EDUCATION

Since the early 2000s, South Asian countries have made much progress in primary education (figure O.2). The number of primary schools in the region has grown substantially, likely because children live closer to schools, especially in rural areas. In recent years, the gender parity index has neared 1—meaning that girls and boys are participating in primary education in equal numbers (figure O.3).

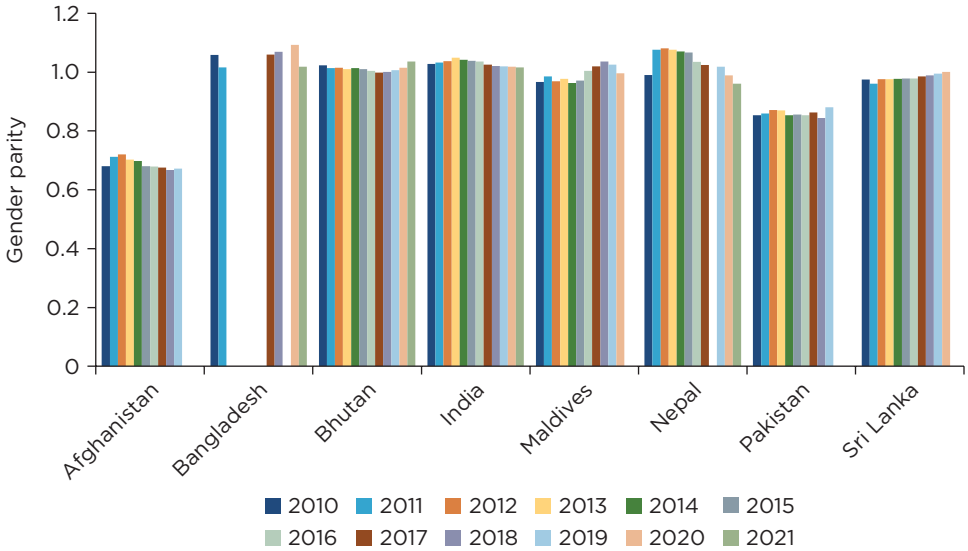
Despite those advances, 11 million children in the region do not receive primary education. The recent gains need to be maintained to bring South Asia up to global averages. And even though education access and enrollment for both girls and boys is growing, STEM education needs to be improved. For students to receive strong primary instruction and potentially pursue careers in STEM, they need to have comparable educational opportunities and the information technology skills needed to thrive in the global economy.

FIGURE O.2 Primary School Enrollment in South Asia, 2010–21



Source: World Bank, World Development Indicators, https://datatopics.worldbank.org/world-development-indicators.
Note: Data are not available for all years in all countries. Missing bars = missing data.

FIGURE O.3 Gender Parity in Primary School Enrollment in South Asia, 2010–21



Source: Adapted from World Bank, World Development Indicators, https://datatopics.worldbank.org/world-development-indicators.
Note: Data are not available for all years in all countries. Missing bars = missing data.

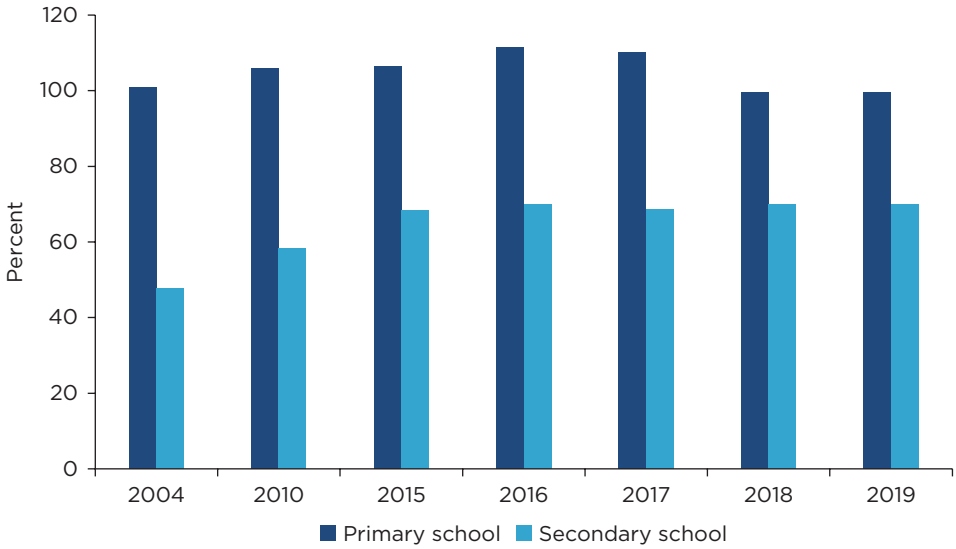
LOWER AND UPPER SECONDARY EDUCATION

Although participation at the secondary level of schooling has increased steadily, secondary school enrollment is much lower than that for primary education (figure O.4). In 2020 the region's out-of-school rate for lower secondary education was 16 percent—twice the rate for primary education.

There was no evidence of gender differences in learning outcomes according to the most recent survey of grades 8 and 10. When provided a chance, girls were as good, if not better, than boys in language, mathematics, and science (NCERT 2017), though scores for both subjects were below scores for other subjects. In Sri Lanka, girls in grade 8 outperformed boys in science and mathematics, and since 2012 both sexes have seen overall improvement. At the General Certificate of Education Ordinary Level in 2012, typically taken at ages 15–16, 76 percent of girls received a passing grade compared with just 58 percent of boys. In the same year, on the Ordinary Level for science, the pass rates were 69 percent for girls and 63 percent for boys; for mathematics, the pass rates were 56 percent and 47 percent, respectively. Across South Asia, upper secondary school is the point at which students focus on their academic interests and skills. Upper secondary school offers tracks including STEM, arts and humanities, and commerce. Some South Asian countries also have tracks dedicated to vocational training at this age.

Across South Asia, girls are underrepresented in STEM streams in upper secondary schools, amplifying the leaky pipeline in engineering. However, girls are interested in health-related careers in the STEM landscape. It might be expected that such students if

FIGURE O.4 Gross Enrollment in Primary and Secondary Schools in South Asia



Source: World Bank, World Development Indicators, https://datatopics.worldbank.org/world-development-indicators.
Note: Gross enrollment = Total enrollment in primary and secondary education, regardless of age, expressed as a percentage of the total population of official primary and secondary school age.

relatively high achieving, could be admitted to STEM tracks in upper secondary school. But that is not always the case.

National enrollment data also show significant variations:

- In Bangladesh in 2018, there were 7.1 million out-of-school youths of upper secondary age, 3.5 times the number out of lower secondary school. About 21 percent of girls and 18 percent of boys dropped out of upper secondary school, although that share has halved for both girls and boys in the past decade.
- In Bhutan in 2019, there were 5 percent more girls than boys enrolled in upper secondary school.
- In India, a critical bottleneck is the lack of available places in public upper secondary schools for students seeking to continue their studies. Moreover, girls' enrollment in private upper secondary schools is lower than that of boys, partly reflecting the perceived costs of raising girls.
- In Maldives in 2019, about 7,200 students (boys and girls) took the A-level examinations following grade 12, but only 676 took the mathematics examination and 613 the physics examination. Clearly, there is limited interest in and emphasis on STEM disciplines in Maldives.
- In Nepal in 2019, 54 percent of the almost 600,000 students in grades 11–12 were girls—up from 47 percent in 2015.

- In Pakistan in 2017, there were 9.8 million out-of-school youths of upper secondary age, almost twice the number not enrolled in lower secondary schools.
- In Sri Lanka in 2019, 56 percent of females were enrolled at the collegiate level (grades 12–13).

Representative enrollment in upper secondary education shows the following:

- In Bangladesh in 2019, 20 percent of girls took the higher secondary certificate science and home economics examination compared with 26 percent of boys. Between 2018 and 2020, the number of girls taking the science examination increased by 10 percent, but it is unclear whether such growth can be maintained.
- In Bhutan in 2021, 16 percent of girls (of 1,138 students) took the science stream, compared with 21 percent of boys. The two STEM courses in which girls' enrollment exceeded boys' were biology and environmental science. The large enrollment of girls in biology reflects their preference for health careers.
- In India, upper secondary schools exhibit significant variations in STEM education streams. Science streams are often oversubscribed, and access depends not only on interest but also results on examination. Coupled with a lack of science tracks in many secondary schools and private coaching that rewards those with the means to focus on tests, access to science in upper secondary school is heavily dependent on socioeconomic status and location (urban or rural). These challenges significantly affect diversity in STEM education and careers for girls and boys alike, but there are variations across states in India (Ramachandran and Shukla 2021; box O.1).
- In Maldives, on average, just 10 percent of school graduates take A-level examinations for mathematics and physics.
- In Nepal, on average, girls account for 38 percent of the science stream.
- In Sri Lanka, extensive data has been collected on STEM tracks at the upper secondary (collegiate) level. During 2018–19 a third of students pursued STEM—in

BOX O.1 Science Tracks in Tamil Nadu, India

In Tamil Nadu, India, the state government provides more access to science tracks, and unlike some other states in India (and countries in South Asia and globally) admission is not based on examination results but rather on student preferences. As a result, 60 percent of upper secondary students in Tamil Nadu choose a science track, with more girls than boys doing so. This access-driven model could increase the number of girls who ultimately pursue STEM careers. Tamil Nadu also reports a larger share of government secondary schools with teachers in science and mathematics than do other Indian states.

Source: Ramachandran and Shukla 2021.

biological science, physical science, biotechnology, or engineering technology. About 41 percent of boys pursued these tracks, compared with 27 percent of girls. Of the 62,000 girls who chose STEM tracks, half selected biological science—2.5 times the number of boys. Many of these students will ultimately choose further study (and careers) in health fields. About 28 percent of girls chose physical science, 15 percent biotechnology, and 7 percent engineering technology, (where fewer than 2 percent of girls enrolled at the collegiate level. By contrast, 52 percent of girls chose the arts track.

Students who choose or are admitted to a STEM track in upper secondary school would be expected to be high achieving. Though data are limited for South Asia, secondary school exit examinations provide insights for some countries:

- In Bhutan in 2021, 97 percent of students in the science stream passed the final board examination for grade 12—more than the national average for arts and commerce, at 90 percent. Moreover, girls had a slightly higher pass rate. On individual STEM subjects, pass rates for boys and girls exceeded 94 percent for biology, chemistry, physics, computer studies, and environmental science. The pass rate for mathematics was 81 percent for girls and 79 percent for boys.
- In Sri Lanka, students can sign up for General Certificate in Education Advanced Level examinations in biology, chemistry, and physics after two years of the collegiate track. About 40 percent more girls than boys pass all three; more girls than boys achieve A scores in all three; and more boys fail all three examinations. STEM pass rates are typically lower than those for non-STEM courses. Though there are half as many girls as boys in STEM streams, more girls take the Advanced Level science examinations. In combined mathematics—where 19,300 boys and 8,900 girls take the examination—just 50 percent of boys pass, compared with 60 percent of girls.

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

Technical and vocational education and training (TVET) provides the skills required for good jobs. Indeed, around the world, most STEM jobs require TVET skills rather than university degrees. Accordingly, many TVET programs are geared toward technology-driven careers. TVET programs are often focused on trades, and in some cases require the development of applied skills that build on the foundations of science and mathematics gained in primary and secondary education.

At its best, TVET integrates classwork with practical applications to solve problems. In South Asia, females are significantly underrepresented in STEM TVET programs.

UNIVERSITY EDUCATION

Around the world—including in South Asia—university enrollment and gender parity have risen significantly in recent years. Still, women remain underrepresented in

engineering and technology disciplines. Many people believe that university graduates with STEM degrees—especially engineers—are essential for socioeconomic development. Employers often bemoan the lack of preparedness of graduates to fill STEM positions, and concerns persist about the quality of STEM education available to many university students.

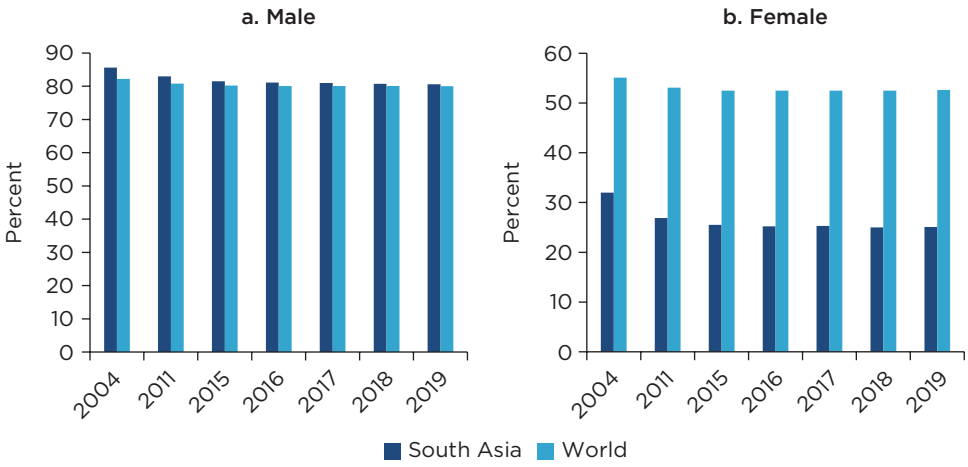
The quality of STEM graduates depends on the quality of their university programs and their preparedness for university education. Engineering disciplines have global standards. Although not all STEM university graduates will find employment in STEM careers, an imbalance remains between available STEM graduates and jobs.

South Asia's STEM Labor Market

Female students do well in STEM studies—around the world and in South Asia. However, with few exceptions (such as Bhutan), gender disparities in labor force participation are worse in South Asia. Men's participation in the labor force in South Asia is much like that globally (figure O.5, panel a). However, with the exception of Bhutan and Maldives, the region's female labor force participation rate is much lower than the global average (figure O.5, panel b).

Unemployment rates also provide insight into the labor market for women and those with more advanced qualifications. Unemployment exacerbates the underrepresentation of women in the workforce, including in STEM disciplines. The underrepresentation of women in the labor force, especially highly educated women, worsens the STEM leaky pipeline observed in education.

FIGURE O.5 Labor Force Participation Rates in South Asia and the World



Source: Adapted from International Labour Organization, ILOSTAT database, https://ilostat.ilo.org/data.
Note: Figure shows labor force participation rate as share of male or female population age 15–64 (modeled ILO estimate).

What Kind of STEM Interventions Does South Asia Need?

As access to all levels of education increases in South Asia—especially for females—the expectation is that more women will enter the workforce. Specifically, more women are expected to pursue jobs and careers that require more advanced skills, including those associated with STEM, and to advance to leadership positions in the STEM workplace, but that will take time. Policy interventions and cultural shifts will be needed to bring greater balance to gender representation in STEM and other career fields.

South Asia needs three types of interventions to limit attrition in STEM subjects as girls and young women choose their education, careers, and personal life paths:

- Interventions that facilitate their enrollment in upper primary and lower secondary education, while putting a spotlight on STEM
- Interventions that plan for and enroll girls in STEM-specific tertiary education in areas where girls show aptitude and interest
- Interventions that guide their entry and early years in the labor force (including for those not currently entering the labor force) in STEM-related jobs.

BOX O.2 South Asia's WePOWER Network: A Success Story

Launched in 2018, WePOWER is a voluntary women's professional network in South Asia. It has two main goals: supporting women's participation in energy projects and institutions and promoting normative changes for girls and women in STEM education. Since its formation, WePOWER has grown exponentially, having completed nearly 1,400 gender-driven activities affecting more than 28,000 female students and professionals and forming 28 partnerships by the end of 2021. With a network comprising a diverse group of public and private stakeholders and an emphasis on locally driven initiatives, WePOWER has had an impressive reach. Results have included the following:

- Job placement for 328 women through job fairs, career counseling, mentorship programs, and the like
- Recruitment of 690 interns and enrollment of 652 female students in study tours
- Participation by 11,156 female professionals in workshops and training.

The program has also led to infrastructure enhancements, with 233 women-friendly facilities built and services provided. Workshops and seminars for returning mothers are also an important area of focus for WePOWER, to promote retention.

Source: South Asia WePOWER Network, www.wepowernetwork.org.

These interventions can be pursued in two ways. The first is by engaged stakeholders that support inclusion in STEM, whether in a specific country or in all of South Asia. These recommendations can be adapted to any aspect of STEM or by any interested stakeholder. South Asia's WePOWER initiative has a diverse network of public and private stakeholders and emphasizes locally driven initiatives (box O.2).

The second requires the full engagement of governments. Though these interventions might be larger in scope and demand fuller policy discussions, they can build on stakeholder interventions and the evidence that has been garnered about these interventions and on global good practices.

Potential Investment Options for South Asia

Potential investment options for South Asia are outlined below. The priority placed on these options will vary by country aspirations, level of development, ability to invest (whether by tapping public or private financing), capacity to secure financing from development partners, and commitment to promoting girls' and women's STEM education and careers. Interventions should be combined to be more effective. For instance, STEM and tertiary education outreach should always be combined with support for women in STEM.

STAKEHOLDER INTERVENTIONS

STEM and tertiary education outreach

To shape students', and their parents', perceptions of STEM sectors and future STEM careers, consider some systematic and standardized resources coupled with a well-designed dissemination model to develop interest in STEM subjects, jobs, and careers, including the following:

- Multimedia aids, such as videos developed by the education sector on STEM-related jobs and economic and societal benefits
- Role models, such as interviews with current employees on jobs, educational expectations, corporate benefits, and career paths
- Open houses and tours, such as at local facilities, including, for example, factories and power plants.

To build relationships with students and strengthen sectoral awareness, build stakeholders' knowledge and human capacity in STEM topics outside of the formal academic environment. Activities can include the following:

- After-school programs focused on STEM problem solving

- Formal science fairs and competitions with coordination and judges provided by STEM stakeholders
- Formal summer camps and programs offering extracurricular STEM programs to interested and talented students.

To encourage students who are studying STEM topics at tertiary institutions to complete their studies and enter the workforce, and to effectively encourage and recruit women to pursue jobs and careers after completing their studies, at both the TVET and undergraduate levels, some dedicated actions are needed to ensure that female students are aware that their full participation in employment is encouraged and facilitated. Outreach activities could include the following:

- Participation of female students/graduates on advisory boards for universities, faculties, and departments
- Targeted career fairs
- Internship programs in STEM sectors
- Presentations on careers and corporate cultures
- Departmental seminars and lectures by sector professionals
- Opportunities to speak with female STEM professionals
- Tours of facilities
- Support through strategic finance and activities, extracurricular clubs, and Women in Engineering chapters.

Support for female STEM students

To recruit a diverse workforce, the following steps could be taken:

- Identify potential employees well before they complete their tertiary education
- Offer scholarships to strong students to ensure that financial constraints are not a burden in finishing a program and build a rapport early in a student's studies
- Provide internships to engender practical experience and introduce students to potential employers, as well as provide opportunities for companies to benefit from the interns' contributions.

Corporate and sectoral outreach and inreach

To recruit and retain a STEM workforce, employers need to demonstrate that their organization values the contributions of female employees and that their commitment

to having an inclusive work environment for women is taken seriously. Potential corporate initiatives for elaboration include the following:

- Equal pay for women, supported by corporate data
- Access to childcare facilities
- Formal maternity and family leave policies
- Professional networking opportunities, including resources and corporate support
- Corporate data on retention and advancement rates for female employees at different levels
- Commitment to female representation on major committees
- Targeted training and mentoring for female employees on leadership and technical skills
- Policies, and actions, supporting women in leadership roles, including, for example, commitments to board memberships.

GOVERNMENT-DRIVEN INTERVENTIONS

Quality STEM basic and secondary education

With increasing enrollment in schools, and increasing demand for STEM education, education systems need to invest in STEM curriculum, teachers, STEM infrastructure (laboratories, workshops, virtual labs for digital learning, and real-life problem-solving techniques and critical thinking necessary to teach to a global standard to prepare a STEM-competent labor force. This includes the following:

- Benchmarking academic performance against international standards, such as the Programme for International Student Assessment and the Trends in International Mathematics and Science Study
- Ensuring that sufficient local capacity exists for those interested in STEM tracks in upper secondary schools
- Prioritizing the availability and accessibility to appropriate water, sanitation, and hygiene facilities for girls and women in all schools and education facilities
- Ensuring that dormitories are available at schools for female students who cannot live at home
- Incorporating problem-based learning into curricula standards
- Creating resilient and sustainable laboratory and information technology facilities in schools at all grade levels

- Prioritizing science fairs and competitions for interested students
- Constructing, where appropriate, dedicated science-focused schools to facilitate access by interested and qualified students.

Quality STEM tertiary education

For most STEM disciplines, academic programs need to combine international standards with local considerations. In addition, targeted interventions to recruit and retain talented women and other underrepresented groups help strengthen STEM programs. Specific initiatives can include the following:

- International benchmarking and accreditation for STEM programs
- Problem-based learning in national accreditation
- Resilient and sustainable teaching, laboratory, and information technology facilities
- Strengthened public research and development funding with specific links to industry partnerships
- Dedicated dormitories and learning communities for female STEM students
- Dedicated scholarship and fellowship programs for female STEM students
- Internship program opportunities in STEM sectors for all STEM students and especially for female students.

Tertiary education teaching

A vibrant STEM sector depends on a strong STEM higher education sector. As tertiary education continues to expand to enroll more women, it is essential that the quality and quantity of faculty members be continuously improved. Specific initiatives could include the following:

- Increasing the percentage of faculty members and lecturers with doctoral degrees (PhDs)
- Increasing the number and proportion of female faculty members in STEM disciplines
- Decreasing faculty-to-student ratios to facilitate better teaching, academic mentoring, and the opportunity for more extensive research
- Extending ongoing support for professional development to ensure that STEM faculty remain at the forefront of knowledge generation and dissemination.

Potential Policy Options and Efforts

Table O.1 provides some policy options and efforts that could address the socioemotional and ecological challenges set out in the hybrid multidimensional framework.

TABLE O.1 Recommendations to Help Girls and Women Pursue STEM Education and Careers in South Asia

All education levels
Data
• Complete disaggregated data on STEM education at all levels are necessary. Readily available data will enable better-designed interventions and stronger alignment between education outcomes (graduates) and employment.
• There is a need—globally, including in the South Asia region—for better disaggregated data that provide a more complete picture of women in the labor market, especially in STEM careers. With better data, additional interventions can be considered that are evidence based. Although International Labour Organization categories are useful, they can be too broad to provide detailed information on, for example, the different types of STEM careers and the training required to best contribute to building a STEM workforce.
Curricula
• To harness contributions from associated sectors, develop and deliver curricula linked to every STEM discipline in tertiary education. Entities from global bodies to local employers can provide formal and informal guidance on course work, lab design and equipment, and even the design of courses, strengthening academic offerings and creating stronger links between students and the sector.
• Although education, and curricula, are generally the responsibility of the government, interested stakeholders can provide additional resources that support learning and that are aligned with curricula objectives. Local and regional challenges offer a concrete path to teaching the importance and relevance of STEM to daily life.
Teachers
• Strengthen teacher training programs and provide the resources to enable schools to have dedicated, qualified science and mathematics teachers so that all students have access to STEM education. This is critical to building the STEM workforce of the future and to ensuring that all segments of society, including women and underrepresented groups, contribute to STEM-based economic development.
• Require training for teachers handling STEM subjects and deploy only these trained teachers to teach the curricula.
• Stipulate that all teachers desiring to teach STEM subjects have a master's-level degree. While acknowledging that credentials are not a guarantee of better teaching, it is noteworthy that in Organisation for Economic Co-operation and Development countries, 47 percent of mathematics teachers and 52 percent of science teachers in lower secondary schools have a master's-level degree. At the same level, approximately two-thirds of mathematics and science teachers are women, providing mentors and role models to students in their classrooms.
• When possible, permit and arrange short-term internships with employers so teachers can learn more about STEM careers and showcase STEM applications and experiential learning
• Mentor teachers on STEM subjects and curricula
• Deliver guest lectures on campus and invite professionals from STEM areas to provide lectures
• Provide internships to faculty members
• Offer research funding and consulting opportunities
• Share equipment, either through donations or access, to build collaborations.

(continued)

TABLE O.1 Recommendations to Help Girls and Women Pursue STEM Education and Careers in South Asia *(continued)*

Secondary, technical and vocational education and training (TVET), higher education, and TVET
Gender stereotyping
• Undertake activities in rural schools to give girls the confidence to pursue STEM education
• Adopt strategic communication strategies to diffuse positive messages about women pursuing STEM fields
• Frame female-friendly policies that enable women to fulfill their professional responsibilities along with their reproductive responsibilities
• Promote a communications strategy about hopes and aspirations of girls and the value of girls pursuing STEM education for higher income generation within families; discourage early marriage and motherhood; discourage the payment of dowries
• Establish a functional body to address cases of sexual harassment
• Nurture the application of STEM education in fields that are perceived to be women friendly; facilitate women's pursuit of home-based work, such as providing ICT-related services
• Introduce innovative measures, such as feminization of STEM subjects and their application to reduce stigma and societal stereotypes attached to STEM subjects.
Role models
• Create strategic communications around the positive role of women in STEM by bringing in role models to diffuse the messages
• Promote career counseling and guidance and facilitate exchange of information by role models to dispel the perception that even if girls are educated, they would have limited livelihood opportunities, such as farming and manual labor.
• Develop STEM- and values-based strategic communications against cultural biases
• Create awareness sessions targeting students, parents, and communities by highlighting female role models, case studies, and job opportunities in TVET institutions
• Set up STEM-focused colleges specifically for women and hire women teachers trained in STEM subjects
• Foster real-life applications of STEM problem-solving and critical thinking among teachers, trainers, and students by using the demonstration effects of women in STEM subjects
• Feminize certain streams to encourage girls and women to enter certain fields, for example, home-based work with ICT-related services
• Provide incentives for STEM-related organizations to increase representation by women, especially at the upper management level, and institute policies to improve the gender composition of upper management in organizations.
Teachers
• Prioritize and focus on teacher training for women in STEM education
• Equalize urban-rural competencies in STEM teacher training through real-life applications of STEM according to the urban or rural environment
• Consider introducing a digital literacy and technology curriculum
• Foster learning and blended teaching-learning in STEM-related subjects
• Create a cadre of subject specialists (women teachers) in science and mathematics at higher education levels

(continued)

TABLE O.1 Recommendations to Help Girls and Women Pursue STEM Education and Careers in South Asia *(continued)*

Teachers

- Offer subsidized—even free—training for women teachers in science and mathematics
- Prioritize and focus on teacher training in STEM subjects with incentives for taking up STEM education
- Prioritize and focus on teacher training in science and mathematics with incentives for urban teachers to teach in rural areas for short periods
- Develop science and computer laboratories in rural schools
- Focus teacher training in STEM subjects to foster technical knowledge and problem-solving skills
- Invest in female teachers and educators to ensure that they have the right knowledge and tools to inspire and help girls who are interested and already enrolled in schools.

STEM educational institutions and career opportunities

- Facilitate the upgrading of teacher training and classroom teaching and learning of STEM to reduce dependence on external coaching centers—which are not accessible to students from the middle class or of lower income status—and to positively influence women's decisions to pursue higher education in STEM
- Focus on STEM teacher training and school subject areas through STEM-related courses at upper or higher secondary education in tribal areas
- Consider setting up "centers of excellence" that include career counseling and assistance to facilitate opportunities in the STEM fields in catchment islands
- Reassess the catchment areas of upper secondary schools to review the distance from home to school for girls and consider options to increase attendance, such as busing girls to school
- Increase the number of upper secondary schools in rural areas
- Offer STEM-related subjects at community campuses, where most girls in rural areas opt to attend higher education
- Introduce incentive schemes to draw young women into STEM education
- Consider the feminization of some of the occupations or trades that are considered to be more "masculine"
- Increase security for girls and women by creating safe schools to stem the fear of gender-based violence
- Promote the establishment of early childhood development centers to provide girls and women with secure options for pursuing their education
- Advocate the recruitment of females to the labor market
- Prioritize career counseling on the importance of STEM
- Ensure greater focus on women and inclusion throughout secondary and higher education policy documents
- Develop family- and female-friendly benefits to retain employees
- Consider accommodating the needs of young people who are working by convening classes in the evenings or on weekends
- Review labor market policies and laws in the medium and long terms to make them more female friendly and with equal wages for similar occupations
- Introduce diverse trades in TVET institutions to complement STEM-related subjects so that women and men can acquire the skills needed to keep up with technological innovation and make the transition to the labor market

(continued)

TABLE O.1 Recommendations to Help Girls and Women Pursue STEM Education and Careers in South Asia *(continued)*

Cost of education
• Consider combinations of subsidies and incentives to address the high cost of higher education, for instance, a menu of options to combine tuition waivers with scholarships, internships with stipends, and low-interest loans with appropriate loan-recovery or waiver options
• Provide targeted state-sponsored scholarships and internships with stipends
• Promote targeted, subsidized additional tutoring for girls from vulnerable social groups and for marginalized populations
• Consider increasing scholarships and freeships for students to encourage students to take science courses and participate in science-related national competitions and exhibitions.
• Undertake a more comprehensive gender review to reform grants, placements, salary scales, and promotions in the labor market
• Introduce female-specific incentive schemes to draw young women into STEM education
• Develop a policy in the long term to offer high TVET-related stipends for female students.

Source: World Bank, based on country background papers prepared for this report.
Note: ICT = information and communication technology; STEM = science, technology, engineering, and mathematics; TVET = technical and vocational education and training.

Considerations for Regional Integration

STEM education and careers in South Asia offer the potential for regional cooperation, provided the challenges can be constructively addressed. Regionally, the sharing of waterways, roadways, railways, and technology have direct bearing on countries' welfare. Further, as part of growing efforts to foster a green economy, the application of STEM education and skills from the upper secondary school, TVET, and university levels will take on new meaning.

With the migration of workers across countries in South Asia, STEM education, skills, and careers are critical ingredients for cross-border trade. Thus, new ways of defining STEM occupations are required in South Asia to enhance STEM education, knowledge, and portability. Preparing a critical mass of semiskilled and skilled STEM migrant workers would have cross-border value, especially for migrants moving from smaller to larger economies.

South Asian countries could collaborate on preferential trade through the South Asian Association for Regional Cooperation (SAARC) to assess the prospects, challenges, and solutions for STEM education and careers and reap the dividends of collective action—whether in trade, tourism, or telemedicine—through the rotating chairpersonship of the SAARC, or by instituting fellowship and scholarship schemes, youth volunteer programs, visa-exemption reciprocity agreements, and more communication networks for journalists. Science and technology is one of the 12 areas of collaboration in the SAARC Integrated Program of Action. There are opportunities for deeper integration through science congresses for solving climate challenges, advancing agriculture technology solutions, and facilitating the exchange of students, professors, and professionals.

Other opportunities for the application of STEM education, knowledge, and skills to foster regional integration include the following:

- Collaborating to create cross-border accreditation of programs and developing equivalence credits across STEM programs
- Providing skills passports to facilitate portability of STEM skills with equivalence credits
- Facilitating knowledge and skills acquisition in areas such as harnessing the use of drones to assess environmental damage—which requires collaborating on the use of airspace in South Asia—and developing the new STEM skills required to guide the programming and deployment of drones, the analysis of data gathered, the geo mapping of hotspots, and the creation of solutions to address the reduction, recycling, and reuse of the materials involved to turn waste into wealth
- Tackling air pollution through renewable energy generation, transmission, distribution, and utilization
- Moving faster to address transboundary weather events and protect South Asia's people by sharing resources, data, and expertise
- Building resilience in food systems and adopting climate-smart strategies for green buildings and transport in cities
- Exploring digital opportunities that encourage intraregional investment in STEM education, expand access to services and markets, create jobs, foster innovation, lower transaction costs, and improve people's lives, including through the pursuit of game-changing solutions to the challenges of digitalization, broadband internet and smartphone access, and cybersecurity
- Drawing on ongoing collaborations, for instance, harnessing the significant untapped hydropower resources in the Himalayan region to help Bangladesh, Bhutan, India, and Nepal trade in electricity, buying and selling surplus power, to meet their power needs with fewer carbon emissions
- Replicating the ongoing collaboration between India and Sri Lanka to boost scientific knowledge, extend cooperation on science and technology, and explore new areas for collaboration on wastewater technology, biotech, sustainable agriculture, aerospace engineering, robotics, big data analytics, and artificial intelligence.

To advance these goals, South Asian countries could host workshops with scientists and innovators to lead discussions and inspire collective action on green jobs and development; strengthen national research and education networks, finance STEM research, and foster the exchange of expertise across education institutions; target scholarships to help and encourage girls and women to remain focused on STEM education in secondary education and beyond; strengthen outreach by the WePOWER initiative to harness

the benefits of collective action and consider similar initiatives in areas such as technology; and invest in cross-border trade.

STEM skills and experiences, coupled with a diversity of perspectives, are integral to building South Asia's STEM workforce in research and to developing new products and ideas. Thus, inclusion and diversity must be championed by governments and by STEM stakeholders that stand to benefit from more diverse workforces.

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APPENDIX

Country Profiles

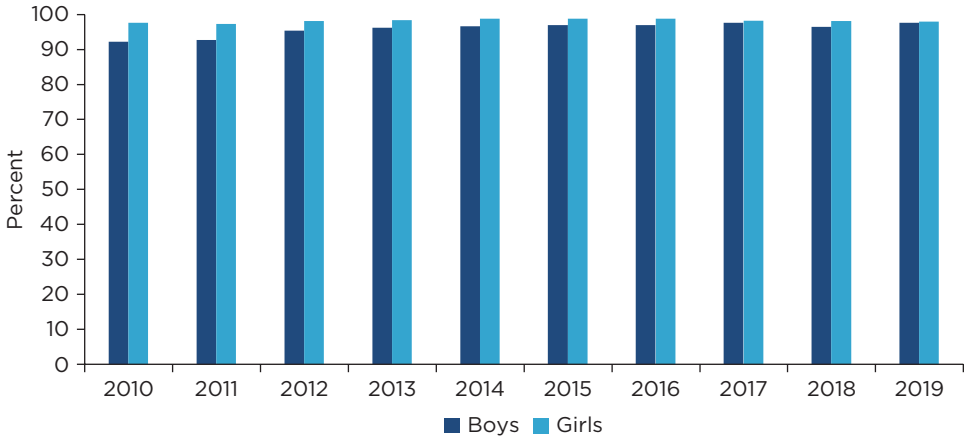
Bangladesh

Although Bangladesh has made enormous strides in girls' education since 2000, rural girls often have fewer opportunities than boys from rural areas, and do not receive a quality education. To address this concern, governments, international development entities, and civil society organizations have supported interventions with impacts large and small, but Bangladesh's education system concentrates on rote memorization—a leading cause of poor achievement and low retention.

PRIMARY AND SECONDARY EDUCATION (GRADES 1–10)

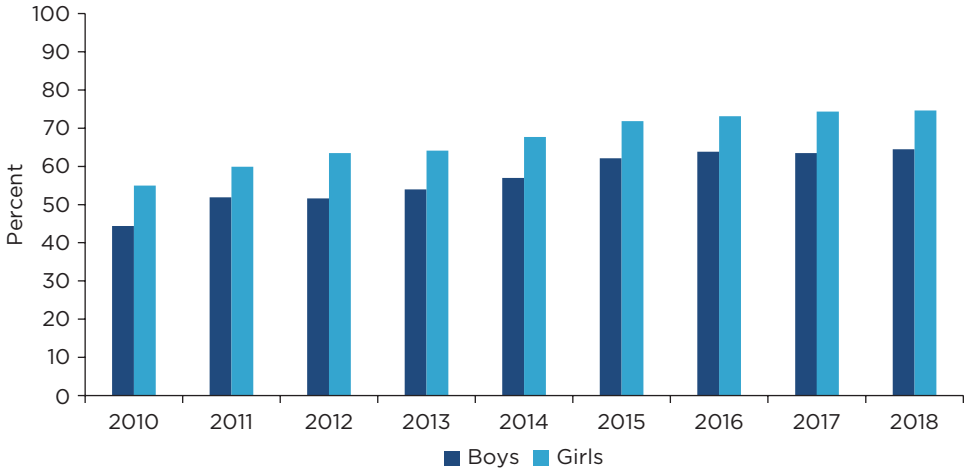
Bangladesh has achieved gender parity in primary and secondary education. Indeed, girls have higher enrollment rates than boys (figures A.1 and A.2). Gender parity is not, however, sustained in higher education, where 46 percent of female students drop out before completion (compared with 34 percent of males). In addition, grade 10 results for 2018–20 show that the share of females studying science was lower than that of males. Female students at that level were more likely to study humanities.

FIGURE A.1 Net Enrollment in Primary School in Bangladesh, 2010–19



Source: Bangladesh Ministry of Primary and Mass Education 2010–19.

FIGURE A.2 Net Enrollment in Secondary School in Bangladesh, 2010–18



Source: BANBEIS 2018.

TERTIARY EDUCATION

In tertiary education, female students in science, technology, engineering, and mathematics (STEM) institutions are limited to medical, dental, and nursing colleges. Enrollment in engineering, textile, and tech institutions remains low. Just 9 percent of female college students take STEM courses. Moreover, female tertiary graduates struggle to find jobs. Unemployment among female tertiary graduates is 21 percent, nearly three times that of males.

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

Although more female students are enrolling in technical and vocational education and training (TVET) institutions, the percentage of female students remains far below that of boys. The case is similar for female teachers in these institutions, with four times as many male as female teachers.

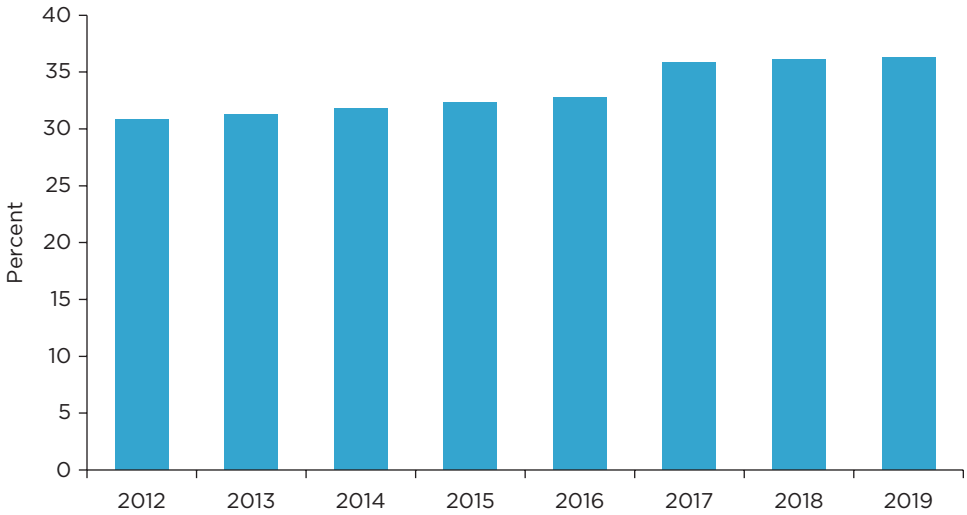
STEM WORKFORCE

Bangladesh has seen a consistent rise in overall female participation in the labor force (figure A.3), although female participation is still half that of males. In contrast, the number of men and women working is almost the same, though the quality of employment is lower for women. And even though included in the employed labor force numbers, women often do not get paid for their work—especially in agriculture—because they are family workers. When women do receive wages, they are far lower than those for men.

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION AND CAREERS

- A shortage of teachers in some schools for some subjects
- Weak school infrastructure for enhancing STEM learning
- Low digital literacy among university students
- Falling wage employment opportunities in farm and agroprocessing industries, leaving women at greater risk of income insecurity.

FIGURE A.3 Female Labor Force Participation Rate in Bangladesh, 2012–19



Source: International Labour Organization, ILOSTAT, https://ilostat.ilo.org/data.

Bhutan

The constitution of the Kingdom of Bhutan guarantees all children free education through the completion of middle secondary school (grade 10). It also mandates that the state provide education to improve and increase the knowledge, values, and skills of the entire population, with education directed toward the full development of human potential. Thus, all Bhutanese students, no matter their ability and interest, study the same science and mathematics curriculum through grade 10.

PRIMARY AND SECONDARY EDUCATION (GRADES 1–10)

The government accords the highest priority to developing the competencies of students in STEM subjects. The Royal Education Council developed a new science and mathematics curriculum for implementation in grade 9 in 2021 and grade 10 in 2020 and will further expanded it to grade 7. The different curricula focus on supporting real-time experiential learning to stimulate the development of critical thinking, communication, creativity, and collaboration. Students in grade 6 are selected to study in a STEM school and to focus on a subject for in-depth study. Since 1978, completion rates for middle secondary education have increased considerably (table A.1).

TABLE A.1 Middle Secondary School Completion Rate in Bhutan

Year	Male (%)	Female (%)
1978	0.9	5.6
2018	90.6	74.6
2020	93.3	77.0
1978–2020	51.8	52.0

Source: Bhutan Ministry of Education 2019.

HIGHER SECONDARY EDUCATION

In 2018, 24,529 students were enrolled in higher secondary education—52 percent of them female. Students at this level choose from arts, commerce, or science streams. Science had the lowest enrollment for both females and males, and in recent years there was no significant increase in female enrollment, perhaps because of the fixed number of courses available at the higher secondary level.

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

TVET has been introduced into the mainstream education system, with programs integrated at all levels of the school system beginning in 2016. Enrollment in TVET requires different qualifications depending on the course and availability.

Most TVET students enroll after failing to secure government-sponsored higher education scholarships. Among the total enrollment of 12,026 over the period 2008–19, 72 percent were males and 28 percent females.

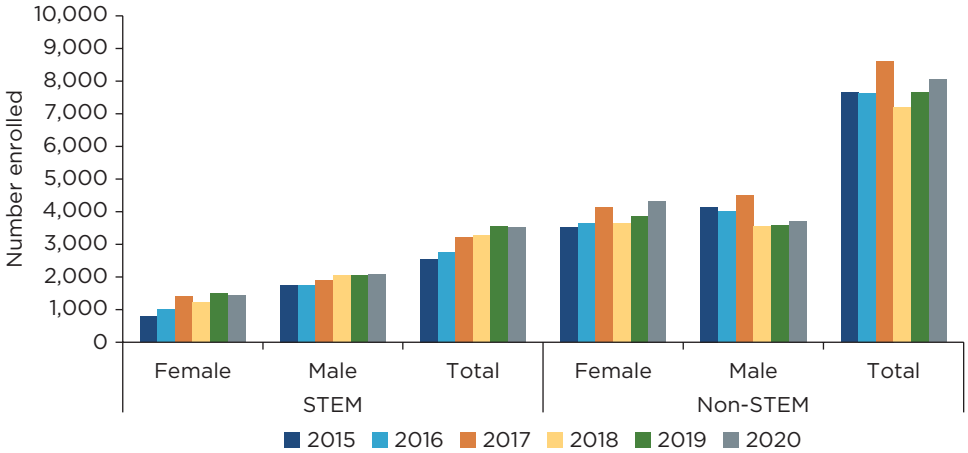
HIGHER EDUCATION

Female enrollment rates are lower in higher education than for males, and also in STEM fields. Male students greatly outnumber females in science and technology, business, engineering, and traditional medicine. In contrast, females outnumber males in nursing, general disciplines, management, language and cultural studies, information technology, and law. During 2015–20, females accounted for 43 percent of STEM students (figure A.4).

LABOR MARKET

The goal of every TVET trainee is to secure a meaningful job. But, among youths ages 15–24, unemployment in Bhutan is 12 percent: 10 percent for males and 14 percent for females. Unemployment is highest among those with a bachelor's degree (13 percent), followed by those with higher secondary (9 percent) and middle secondary (4 percent) educations. Females account for less than a third of employed TVET graduates, and only 61 percent of female TVET graduates were employed, compared with 80 percent of male TVET graduates.

FIGURE A.4 Gross Enrollment Trends in STEM and Non-STEM Streams in Bhutan, 2015–20



Source: Bhutan Council for School Examinations and Assessment 2021.
Note: STEM = science, technology, engineering, and mathematics.

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION AND CAREERS

- Parents' economic status is important for girls who do not receive state scholarships, and girls' household obligations may keep them from completing secondary, higher secondary, and more advanced education.
- TVET is considered college for poor people. Training and working conditions for TVET graduates, especially women, are not congenial.
- Women in Bhutan perform 71 percent of unpaid care work, which largely goes unrecognized.

India

India has a large pool of young people who complete graduate-level courses, yet many remain unemployed. As a result, Indian industry faces a shortage of trained workers. Moreover, schools and higher education institutes face challenges in producing graduates with adequate knowledge and skills.

PRIMARY AND SECONDARY EDUCATION (GRADES 1–10)

The primary and secondary levels determine whether students enter higher secondary school. Although India has made much progress on primary education since 2000, only 30.7 percent of students make it to higher secondary schools, with more girls than boys doing so, even across social (socioeconomic strata, across castes, and scheduled castes and scheduled tribes) groups. Table A.2 provides the net enrollment ratio in India for girls and boys by level of education.

TABLE A.2 Net Enrollment Ratio in Schools in India, by Level and Gender, 2014–19

Level	Gender	2014–15	2015–16	2016–17	2017–18	2018–19
Primary	Girls	98.9	99.3	96.4	94.8	94.3
	Boys	97.9	98.3	95.7	93.8	92.9
	Total	**88.4**	**98.7**	**96.0**	**94.3**	**93.6**
Upper primary	Girls	81.1	82.7	80.8	81.2	77.9
	Boys	78.4	79.9	78.6	79.4	76.0
	Total	**79.7**	**81.2**	**79.6**	**80.3**	**76.9**
Secondary	Girls	53.8	58.4	58.1	59.5	56.1
	Boys	54.1	58.2	57.9	59.2	55.2
	Total	**54.0**	**58.3**	**58.0**	**50.3**	**55.6**
Higher secondary	Girls	28.6	27.0	26.0	20.8	31.6
	Boys	28.8	27.6	26.4	29.2	29.9
	Total	**28.7**	**27.7**	**26.7**	**29.5**	**30.7**

Source: India Unified District Information System for Education dashboard, https://dashboard.udiseplus.gov.in/#/home.
Note: STEM = science, technology, engineering, and mathematics.

Moreover, there are no significant differences between the average performance of girls and boys in science and mathematics (table A.3). Thus, the main concern is why gender differences persist in postsecondary technical enrollment.

TABLE A.3 Average Score of Students on the National Achievement Survey in India, 2017 and 2018

		Gender			Social group			
Class	Subject	National average	Male	Female	Scheduled caste	Scheduled tribe	Other backward classes	General
VIII	Language	307	306	308	302	299	310	312
	Mathematics	269	269	269	264	265	272	267
	Science	274	275	274	270	273	277	273
	Social studies	278	278	279	273	278	281	277
X	English	253	251	255	246	245	252	264
	Mathematics	254	255	253	247	246	255	262
	Modern Indian language	254	253	255	252	244	253	261
	Science	253	252	253	249	248	253	257
	Social studies	254	254	254	251	248	255	258

Source: Government of India Ministry of Education 2020b, 2021.

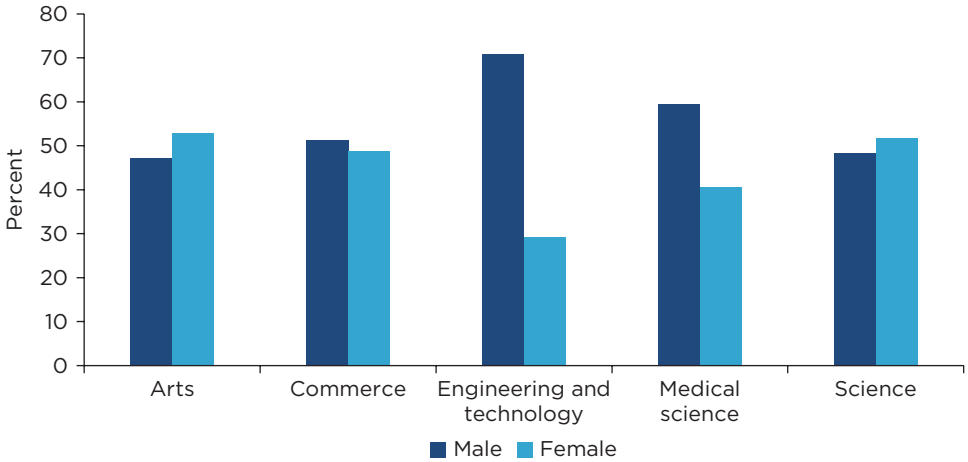
HIGHER SECONDARY EDUCATION

Subject teachers are lacking in higher secondary schools. Nearly 40 percent of secondary schools do not have mathematics teachers; a third do not have science teachers (Government of India Ministry of Education, 2015). These shortages might influence student choices and participation. Moreover, many schools in tribal areas do not offer science classes, leaving students with no choice but to enter the arts stream.

HIGHER EDUCATION

Participation differs by gender more in higher education. In streams like arts, general science, commerce, information technology, and some other nonscience disciplines, gender differences are insignificant (figure A.5). But many more women opt for medical sciences and education disciplines, and only 3.1 percent of women are enrolled in technical and professional courses. Traditional engineering disciplines—civil, electrical, mechanical—attract fewer women than men. Yet, women outnumber men in contemporary engineering disciplines such as computer science, electronics, and information technology. Moreover, women's participation in STEM has increased and is likely to further improve in new disciplines such as artificial intelligence and biotechnology.

FIGURE A.5 Undergraduate Enrollment in Major Subjects in India, 2019–20



Source: Government of India Ministry of Education 2020a.

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

India has seen steady growth in the number of TVET institutions. Between 2000 and 2019, the number of industrial training institutes almost quadrupled to 16,000, of which 80 percent were private. Some 3.4 million students are enrolled in these institutes, although only 11 percent were female (Government of India Ministry of Skill Development and Entrepreneurship, 2016).

LABOR MARKET

Female labor force participation is low, indicating that many highly educated women—often with degrees in STEM fields—are not working. More men are employed in all sectors. Thus, women face disadvantages in the labor market. And women's participation in science education is skewed regionally. Most women scientists belong to forward castes, with negligible participation from other social groups (Kurup et al 2010).

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION

- Low learning outcomes, starting at the primary level, inhibit the transition of women to STEM in higher education. Moreover, high entry barriers prevent entry to science streams in higher secondary schools.
- Availability of local schools offering STEM subjects is low, and the distances that students need to travel in rural areas to attend higher secondary schools are problematic.

- At the postsecondary level, some professions have become feminized and others are dominated by men. These differences are seen across and within STEM disciplines and streams.

Maldives

According to the government of Maldives, STEM education raises two main issues. First, most students pursue business because the science stream is not available on their home islands. Accordingly, few students pursue STEM subjects in higher education. Second, demand is greater than the supply of STEM-educated graduates in local industries such as energy and climate resilience. The government's strategic action plan includes regulations to support women's participation in STEM and funding for STEM education.

GENERAL EDUCATION (GRADES 1–12)

Maldives imposes no barriers on either sex in attaining general education. A survey conducted for the Maldives STEM Education and Careers Country Report (2021) found, however, that more than half of students in general education were unaware of or did not have enough information about STEM. Of those, nearly three-quarters were girls. And though mathematics is compulsory in secondary education, only 45 percent of enrolled girls study science, compared with 51 percent of boys.

HIGHER EDUCATION

Of the 40 fields of study offered in higher education institutions, only 10 are related to STEM—and only at the bachelor's level (table A.4). The rest involve non-STEM fields, such as education, arts and humanities, business administration, journalism, health and welfare, law, and services. Moreover, students have limited opportunities for scholarships and loans for STEM fields.

LABOR MARKET

In 2014, the labor force participation rate was 79 percent for men and 47 percent for women. Between 2009 and 2014, the country's unemployment rate for men dropped from 7.9 percent to 4.8 percent, and for women from 23.7 percent to 5.9 percent.

TABLE A.4 Bachelor's Degrees in STEM Offered in Maldives

Main field	Field of study
Natural sciences, mathematics, and statistics	Biology
	Earth science
Information and communication technology	Database and network design and administration
	Software and application development and analysis
Engineering, manufacturing, and construction	Chemical engineering and processes
	Electricity and energy
	Mechanics and metal trades
	Motor vehicles, ships, and aircrafts
	Food processing
	Materials (glass, paper, plastic, and wood)

Source: Republic of Maldives Ministry of Higher Education 2020.
Note: STEM = science, technology, engineering, and mathematics.

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION AND CAREERS

- Lack of information, opportunities, and qualified teachers
- Sociocultural barriers, such as early marriage for both boys and girls
- Lack of mentorship in STEM fields for students and young people aspiring to STEM careers
- Lack of job opportunities and higher education opportunities in STEM fields, especially on the islands.

Nepal

In recent decades Nepal has reduced illiteracy and expanded access to pre-university education, significantly increasing the number of students enrolled at the basic and lower secondary levels. Still, gender disparities remain in education. For example, in 2019 compared with other island nations, Maldives had the lowest net enrollment rates in upper (higher) secondary education against gross national income per capita. Boys tend to drop out because of difficult and expensive sea travel from one island to another in nearly all atolls; children age 16 and older, especially boys, can engage in income-earning activities and may opt to leave school and join the labor market; some students at age 16 and older opt for TVET; and some families who can afford to do so send their children at age 16 to school overseas for STEM studies, medicine, and other fields.

PRIMARY AND SECONDARY EDUCATION (GRADES 1–10)

Girls and boys have similar promotion rates at the primary and secondary levels (figure A.6). Moreover, dropout rates have fallen for all students—but with lower dropout rates for girls across all grade clusters. In grade 3 there was no gender difference in the average score on mathematics, and in grade 5 girls scored slightly higher than boys. But by grade 8, boys outscored girls in mathematics and science. Thus, the gender divide in mathematics and science learning may start in grade 8, which is important because students must choose between STEM and non-STEM subjects in that grade.

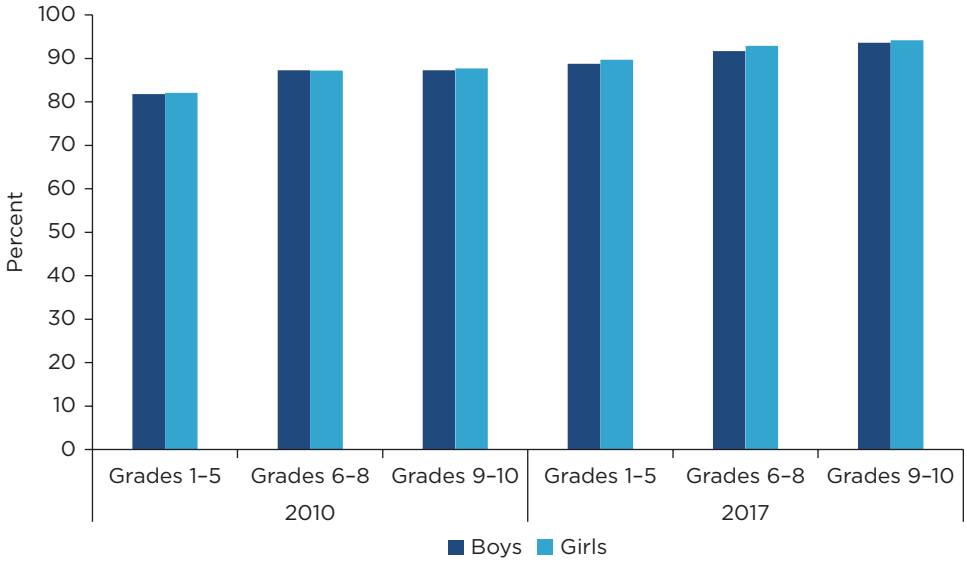
HIGHER SECONDARY EDUCATION (GRADES 11–12)

More girls than boys are enrolled in higher secondary education, which is a major social milestone, given that most girls in Nepal are married by the time they are age 17 or 18. Still, girls take science examinations at a much lower rate than boys (figure A.7).

HIGHER EDUCATION

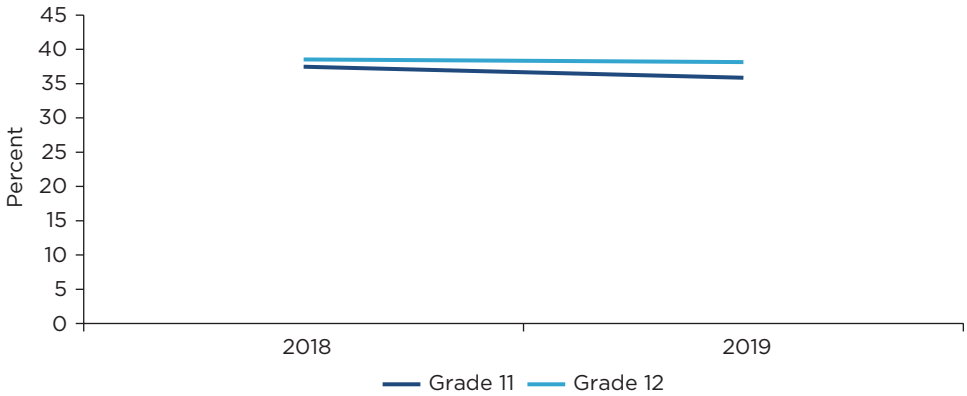
Gender differences in STEM become especially pronounced in higher education. The share of female graduates in some STEM subjects—engineering, science, and technology (table A.5)—is the lowest among South Asian countries. The female-to-male ratio is much higher in management, education, humanities, and social sciences.

FIGURE A.6 School Promotion Rate in Nepal, by Gender, 2010 and 2017



Source: Nepal Ministry of Education, Science and Technology 2010, 2017.

FIGURE A.7 Share of Females Appearing for Examinations in the Science Stream in Nepal, 2018–19



Source: Nepal Ministry of Education, Science and Technology 2020.

TABLE A.5 Enrollment in STEM-Related Subjects in Higher Education Institutions in Nepal, 2018–19

STEM-related subject	Male	Female	Share of females (%)
Agriculture	660	285	30.2
Animal science, veterinary science, and fishery	261	92	26.1
Engineering	24,127	4,891	16.9
Medical sciences	7,469	11,085	61.2
Science and technology	23,662	13,365	36.1

Source: University Grants Commission Nepal 2020.
Note: STEM = science, technology, engineering, and mathematics.

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

Large shares of females are enrolled in health diploma programs, with a gender parity ratio of 2.36. But for engineering diplomas, gender parity is just 0.21, and for agriculture it is 0.84—reflecting traditional male preferences for those subjects. TVET is considered a second-best option in Nepal, often ignoring its academic and career potential.

LABOR MARKET

The labor force participation rate in Nepal is 39 percent, with 54 percent for men and 26 percent for women. In addition, the unemployment rate for women is

13.1 percent—compared with 10.3 percent for men. Thus, many women are not in the labor force, and those searching for jobs are not getting them.

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION AND CAREERS

- Female students tend to be less confident about their STEM abilities. Even though science and mathematics are compulsory school subjects, teaching and learning are of very low quality.
- There is a shortage of female STEM teachers.
- Colleges tend to have a male-oriented culture, which can make it hard for women to feel comfortable.
- Parental support for women's education falls after the bachelor's level.
- Women face social barriers and differential treatment in the labor market.

Pakistan

STEM education is a relatively new concept in Pakistan. Still, with the rapid global development of science and technology, it has become an important approach to enabling innovative learning. Some 60 percent of Pakistanis are younger than 30. So, investing in STEM education and careers is a practical, pressing need for economic growth. Although the government has introduced a few STEM policies, education does not receive the attention it deserves. Since 2018, budget allocations to education have averaged just 2.3 percent of GDP, which is well below the international benchmark of 4 percent to 6 percent of GDP.

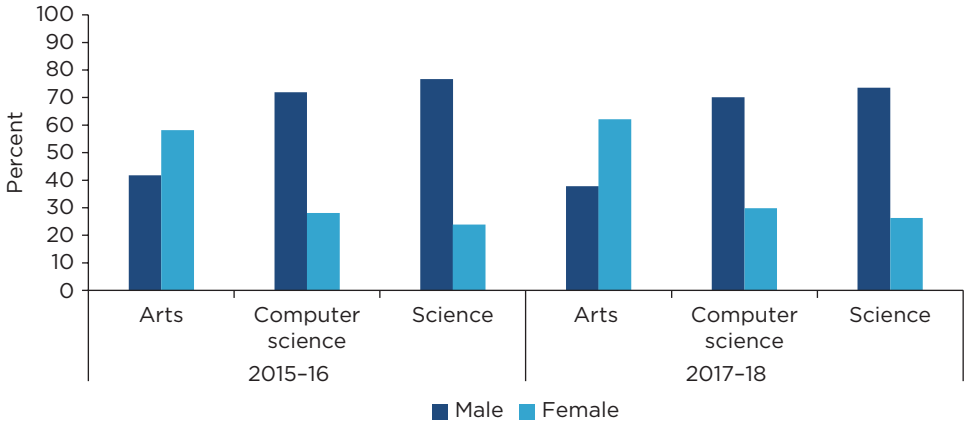
PRIMARY AND SECONDARY EDUCATION (GRADES 1–10)

Public schools teach 56 percent of students; the rest are enrolled in private institutions. About 56 percent of all students are male, and 44 percent are female.

HIGHER SECONDARY EDUCATION

Enrollment is falling for female students in higher secondary school in Khyber Pakhtunkhwa province, and there are considerable gaps relative to male students, reflecting the limited availability of female higher secondary institutions. More girls are enrolled in arts than in science and computer science (figure A.8). In Punjab, female enrollment has been rising as a result of better access to schools in the province, but the trend in girls' enrollment in arts relative to science is similar.

FIGURE A.8 Enrollment in High School in Khyber Pakhtunkhwa Province, Pakistan, by Subject, 2015–16 and 2017–18



Source: Pakistan Ministry of Federal Education and Professional Training NEMIS Database 2015–16, 2017–18.

TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

After completing midlevel education, students can opt for a technical or vocational stream for two years at the lower secondary level. Institutions throughout the country offer such courses. Students can continue to higher secondary levels while enrolled in technical and vocational institutes. In Khyber Pakhtunkhwa and Punjab, female enrollment is rising for vocational training but is quite low in technical education. One reason women's enrollment is lower than men's is the type of trades offered, which are of limited interest to women.

LABOR MARKET

Women account for fewer than 18 percent of Pakistan's engineers, scientists, mathematicians, technologists, and inventors. Leveling the playing field for women in STEM would create opportunities and unleash an untapped resource for the energy sector.

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION

- Negative gender stereotypes
- Lack of female role models and absence of guidance
- Lack of teachers for STEM subjects with the needed technical knowledge and problem-solving orientation
- Lack of higher education institutions and unaffordability of the ones there are
- Lack of mobility or transport facilities to educational institutions.

Sri Lanka

Sri Lanka aspires to become globally competitive by integrating technology into every sector of its economy, investing strategically in new technologies, and linking the education system to innovations. Thus, the country needs to develop a generation of students with the knowledge, skills, and attitudes required to achieve technological advancements and innovations that enhance productivity in a sustainable way. The government has introduced policies to encourage demand for education, including free schools, subsidized public transport, scholarships for grade 5, and a health insurance scheme. In addition, different types of schools provide opportunities for students to pursue different subject streams at the collegiate level.

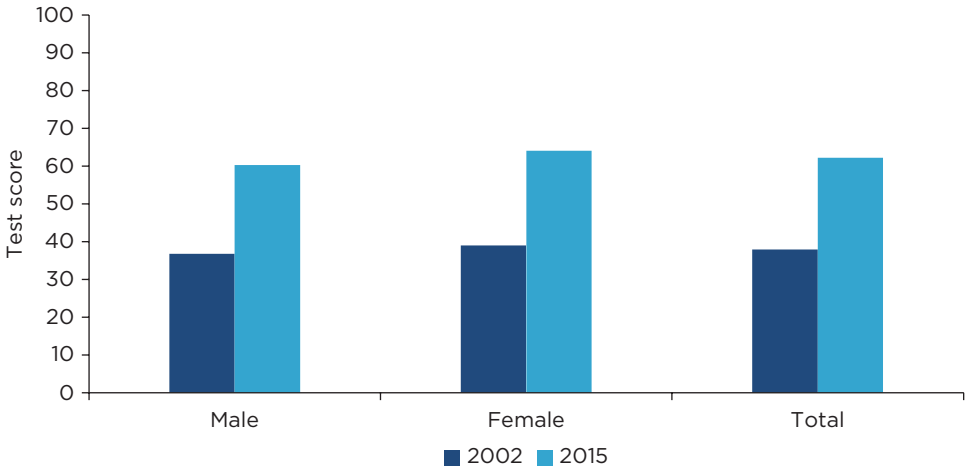
PRIMARY EDUCATION (GRADES 1–5)

At the primary level, STEM education is limited to mathematics and environmental studies. A national assessment of grade 4 students in mathematics found that girls scored higher than boys in both 2002 and 2015 (figure A.9). Moreover, an assessment of 2019 grade 5 examinations revealed gender differences, with 54 percent of girls and 46 percent of boys scoring above the cutoff marks.

SECONDARY EDUCATION (GRADES 6–11)

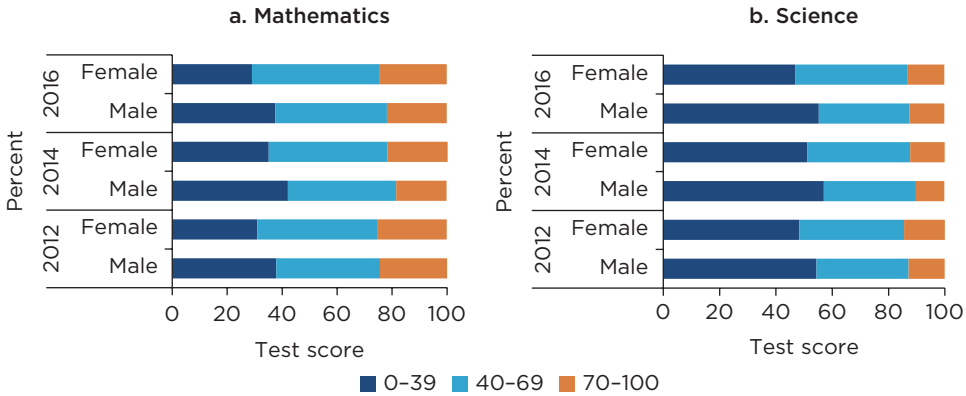
At the secondary level, in addition to mathematics, students are introduced to science, practical technical skills, and health science. Many schools with computer labs also offer classes in information and communications technology. National assessments of

FIGURE A.9 Mathematics Assessment in Grade 4 in Sri Lanka, by Gender, 2002 and 2015



Source: NEREC 2004, 2017.

FIGURE A.10 National Assessment of Grade 8 Learning Outcomes in Mathematics and Science in Sri Lanka, by Gender, 2012, 2014, and 2016



Source: NEREC 2013, 2015, 2017.

grade 8 students in mathematics and science in 2012, 2014, and 2016 indicated that girls outperformed boys in these subjects (figure A.10).

COLLEGIATE EDUCATION (GRADES 12–13)

At the collegiate level, students can select biological science, physical science, biotechnology, or engineering technology streams. They can also choose non-STEM subjects, such as commerce, arts, and vocational streams.

TECHNICAL VOCATIONAL EDUCATION AND TRAINING

Female access to STEM TVET is limited because TVET is considered the domain of males.

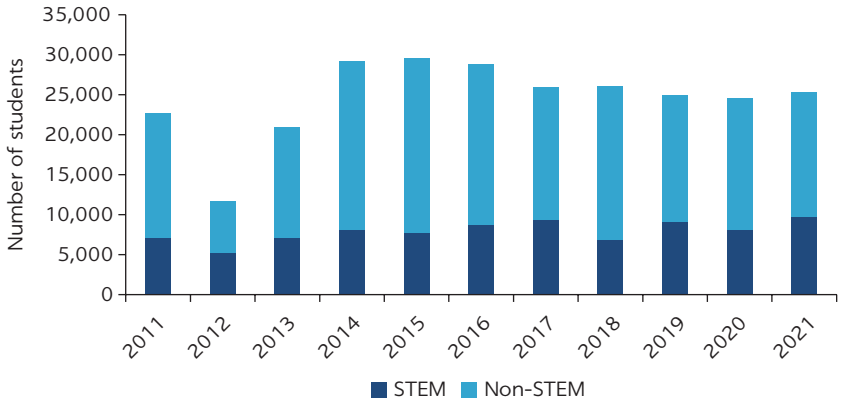
HIGHER EDUCATION

More females graduate from non-STEM streams, such as arts, education, management, commerce, and law, and more males graduate from STEM streams, such as engineering, architecture, and computer science. The number of STEM and non-STEM graduates of state universities is shown in figure A.11. More postgraduate female students graduate with non-STEM than STEM degrees, so enrollment among females in STEM postgraduate degrees should be encouraged.

LABOR MARKET

Sri Lanka's labor force consists of 8.1 million workers, but female participation is just 34 percent. In 2019, 45 percent of workers were engaged in STEM-related occupations.

FIGURE A.11 STEM and non-STEM Graduates of State Universities in Sri Lanka, 2011–21



Sources: University Grants Commission, 2011–21; World Bank calculations.
Note: STEM = science, technology, engineering, and mathematics.

FACTORS IMPEDING WOMEN'S ACCESS TO STEM EDUCATION AND CAREERS

- Shortages of teachers in some schools for some STEM streams
- Limited infrastructure facilities in some schools to enhance STEM learning
- Social perceptions that some occupations are better suited to males.

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green press INITIATIVE

Building a skilled and diverse science, technology, engineering, and mathematics (STEM) workforce is crucial for economic development, cross-border trade, and social inclusion in South Asia. However, underrepresentation of girls and women in STEM education and careers remains a persistent issue. What kinds of macro and micro socioeconomic interventions are needed to increase girls' and women's access to and participation in STEM education and careers in South Asia?

Engendering Access to STEM Education and Careers in South Asia compares trends in South Asia with global trends to examine how access to and choices of STEM fields affect girls' enrollment in upper secondary education, technical and vocational education and training, and higher education in the region as well as their selection of careers. Based on the analysis, it offers recommendations to policy makers and practitioners to improve inclusion. The following are among the findings:

- The five key opportunities to foster inclusion and enrollment in STEM education—and staunch the "leaky pipeline"—are at the upper primary, lower and upper secondary, and tertiary education levels, and during the early career years.
- A strong pathway from STEM education to career depends on an integrated, systematic approach that motivates students to pursue STEM fields, builds STEM skills, and removes barriers to diversity.
- With the increasing migration of workers between countries in South Asia, preparing a critical mass of semiskilled and skilled STEM migrant workers has cross-border value, especially for workers migrating from smaller to larger economies.

New ways of defining STEM occupations are required to help develop and sustain female interest in STEM education and careers. Potential strategies that governments can pursue include raising awareness and building knowledge and skills in STEM outside the formal academic environment—such as in after-school programs, science fairs and competitions, and summer camps—and developing and systematically disseminating standardized resources. Inclusion and diversity must be championed by governments, the private sector, and other stakeholders who stand to benefit from more diverse workforces. Though women themselves would likely be credible champions, in South Asia they are often constrained by a range of factors. This report addresses some of those obstacles.

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