Attracting More Young Women into STEM Fields[1]

- Science, technology, engineering, and mathematics (STEM) are vital to the economic and social prosperity of countries. Societies that understand STEM-related topics are better able to respond to global challenges.
- STEM education for girls and women should be a priority for policy makers. One of the reasons, for instance, is that girls and women can play pivotal roles in the green transition which can only be accelerated by ensuring their equal access to education and career opportunities in STEM fields.
- Yet, women and girls in LAC continue to be underrepresented in STEM careers with wide variation among countries and across STEM fields. In most countries of LAC, women account for no more than 40% of graduates in STEM fields.
- Through STEM education, female students are prepared for the job market of the future. The gender gap in STEM represents a missed opportunity for economies and an inefficient allocation of labor and talent and creates income disadvantages for women.
- The WBG supports countries to challenge and shift gender norms and stereotypes that negatively affect girls' interest, engagement, and achievement in STEM education, as well as provides incentives for young women to choose STEM education and careers.
- Evidence suggests that promising interventions to foster female participation in STEM include addressing gender biases in learning materials, engaging parents of girls and reshaping their attitudes toward the participation of girls in STEM subjects, encouraging participation in extracurricular activities, and featuring female role models in STEM fields.

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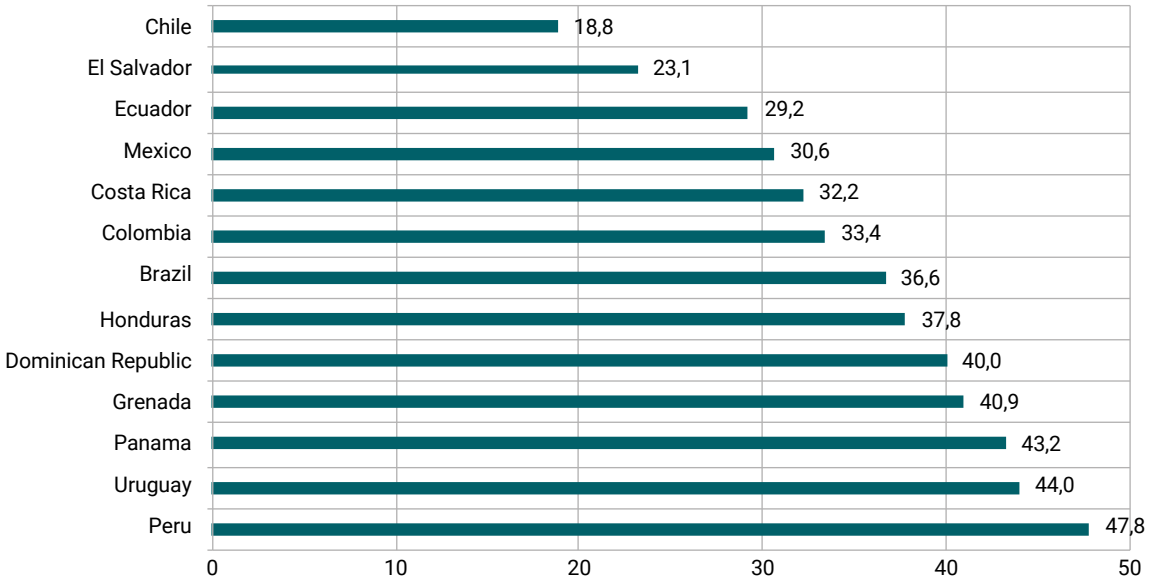
THE CONTEXT

In most countries of LAC, women account for no more than 40% of graduates in STEM careers. Available country data confirms that a gender gap in STEM prevails in post-secondary education (**Figure 1**). A metaphor frequently used to explain this underrepresentation of women in STEM careers is the "leaky pipeline" (Hammond et al., 2020; Schomer and Hammond, 2020; UNESCO, 2022). This means that although girls' performance in math and science is often as good as or better than boys' at the primary and secondary levels, few women enroll in STEM graduate programs, and, later, few join the workforce in STEM sectors, which include jobs that can potentially support the green transition. For example, as of 2018, the share of female researchers working on engineering and technology topics was between 19% in Bolivia and Peru and 37% in Ecuador (UNESCO, 2022). Women also continue facing additional barriers to reach high seniority levels across research positions in STEM fields, a phenomenon described as "horizontal segregation."

Multiple overlapping dimensions that interact in complex ways influence women's education, employment, and progression in STEM careers. Gender stereotypes and biases are key drivers which are present at all levels—across societies, classrooms, and families. Starting in primary school, and continuing through secondary and tertiary education, girls' interest and confidence in STEM subjects are often shaped by social and gender norms that come into play when learning these subjects as well as when they are choosing their careers (Hammond et al., 2020; Schomer and Hammond, 2020). During the school-to-work transition, information asymmetries and legal barriers may also limit the share of young women who, for instance, enter infrastructure industries or occupy certain STEM-linked roles. Likewise, gender gaps are also present in the distribution of STEM teaching staff in higher education at several universities within the region.

Figure 1: There is a Low Share of Female Graduates in STEM Fields.

Percentage of Female Graduates from STEM Programs in Tertiary Education, 2017-2018



Source: World Bank Gender Statistics taken from UNESCO Institute for Statistics (http://uis.unesco.org/)

Note: STEM includes science, technology, engineering, mathematics and computer science.

EVIDENCE OF WHAT WORKS

According to a recent World Bank report that reviews the global evidence of how to increase female participation in STEM (Hammond et al. 2020), promising interventions include:

- **Addressing gender biases in learning materials and teaching methods**. For example, biographies of women who have succeeded in male-dominated fields can shift the career aspirations of girls from traditional to nontraditional. Studies show that kindergarten boys and girls are equally enthusiastic about math and science; however, one-size-fits-all teaching reduces girls' interest and perpetuates the idea that STEM is not for girls.
- **Engaging girls' parents to reshape parental attitudes toward female participation in STEM**, as parents influence children's achievements and aspirations. For example, informing parents about the advantages of choosing STEM classes through brochures or websites can increase their support toward female participation in STEM classes.
- **Featuring female role models and providing mentorship to close the belief gap.** Role models provide examples of the kind of success one may achieve ("I can be like her") and often also supply a template of the behaviors that may be needed to achieve success.
- **Encouraging participation in extracurricular activities.** Museum visits, competitions, extracurricular clubs, and robotics and coding camps can foster interest in STEM among both boys and girls.
- **Informing about STEM careers.** Access to more information about the career possibilities and returns of studying STEM can increase girls' interest and influence their educational choices.
- **Adopting deliberate strategies to attract, retain, and promote women in STEM fields.** Companies can be pro-active, for instance, by reaching out to schools and universities and speaking to students about the opportunities in STEM sectors. Other strategies include rolling out personal development courses, technical skills training, and hosting internship programs.
- **Adopting workplace practices and policies that meet women's needs to attract and retain women in STEM professions**. These options are not relevant only to STEM jobs, and include examples such as parental leave, childcare services, anti-sexual harassment policies, and flexible hours.

Given the scarce evidence of tested interventions in LAC, the following describes empirically tested studies from LAC and other countries that aim to increase young women's attraction to STEM fields.

- ***Providing role models for girls in school may reduce the gender gap in STEM enrolment at the tertiary level.*** In **Peru**, a randomized control trial found that exposure to mentorship increased the preference for engineering programs among high performing female students. The interventions included visits to 109 secondary schools in 18 Peruvian cities by senior female engineering students or recent graduates from a top university in Peru. The mentors studied either civil, industrial and systems, or mechanical and electrical engineering. Visits consisted of brief talks where mentors highlighted a number of issues to challenge students' beliefs and interests such as the differences between the male and female brain; the capability of girls to become engineers; the contribution of female engineers to the creation of things around the world; seeing STEM as a tool or opportunity to improve the world and solve problems; and the mentor's own experience. Of the 5,378 students who participated, results showed that among girls who had math scores in the top 25th percentile, interest in STEM fields increased by 14 percentage points, while their self-confidence and ability to pursue these areas increased by 12.5 percentage points.
- ***Information interventions about labor market returns of education increase learning outcomes.*** In **Mexico**, a randomized control trial of the *Percepciones* pilot project in 54 technological upper-secondary schools, run by the Federal Government, provided information on the returns to education in the form of additional earnings perceived by individuals who completed upper secondary and worked full-time. Information was based on the estimated net present value of the additional income flows assuming entry and exit to the labor market at ages 25 and 65. While the intervention had no effects on high school completion, it improved standardized test scores and self-reported measures of effort. Effects on standardized test scores were larger for girls as well as students from households with relatively higher incomes.
- ***Information about gender equality in STEM can increase not only girls' interests but also encourage parents to support their children's preparation and motivation in STEM***. In **Japan**, an online survey experiment found that providing information on gender equality and STEM (i) increased the motivation of junior high school students to pursue studies in STEM; and (ii) increased parents' motivation to encourage their children to choose a STEM career. The survey provided information on the availability of STEM occupations and women's underrepresentation in education; it also challenged social stereotypes of girls "not being good" at math and of women in STEM being thought of as "intellectuals."

- ***Involve teachers and use more engaging teaching methods to increase female interest in STEM.*** A mixed methods research study in **Chile** and **Colombia** used educational robotics to develop STEM competencies for schoolteachers with a gender focus. Educational robotics is of growing interest in STEM at all levels, especially to promote STEM careers for women. For example, the use of a robot in programming education can help girls better grasp computer science concepts. In this study a set of workshops were designed to make use of Arduino—a technology that allows for introducing concepts in electronics and programming. The workshops devoted half an hour to teaching theory with 90 additional minutes for practice. Out of the 290 participants, 52.5% were women. Feedback from the course showed that the workshops increased teachers' knowledge of robotics and their interest in passing it on to their students. Students' creativity, attitude, and motivation toward robotics also grew.

HOW ARE WBG PROJECTS ADDRESSING THIS ISSUE?

The WBG is supporting countries to challenge and shift gender norms and stereotypes that negatively affect girls' interest, engagement, and achievement in STEM. Moreover, the WBG is actively providing incentives for young women to choose and remain in STEM careers.

- In **Brazil**, the Support to Upper Secondary Reform Project (P163868) uses school-based interventions to tackle social barriers and unconscious biases that prevent girls from studying natural sciences and math. These interventions include (i) professional development for teachers to increase the use of practical and applied strategies in the teaching of natural sciences and math; (ii) raising awareness of unconscious gender biases among teachers and principals; (iii) creating strategies to build a "science identity" for girls; and (iv) removing gender stereotypes and biases from learning materials.
- In **Ecuador**, the Transformation of the Tertiary Technical and Technological Institutes Project (P157425) partners with employers to boost female enrollment in technical and technology fields. The gender plan includes activities such as (i) identifying barriers for students and designing actions to ensure equal opportunities for women and men; (ii) developing a communications strategy to promote equal technical and technology education access; and (iii) creating mechanisms to prevent gender-based violence or discrimination in the Technical and Tech Training Institutes.
- In **Peru**, the Strengthening Peru's National Science, Techology and Innovation System (P176297) supports mechanisms to attract more women researchers in competitive grant applications and awards. To this end, the project ensures that (i) the selection and evaluation process avoids gender bias, especially during the peer review of proposals; (ii) awards more points to women researchers, researchers outside Lima, and women and men researchers under 35; and (iii) prioritizes women-led proposals for the entrepreneurship grant windows. As part of the project, institutions receiving grants will be required to monitor beneficiary data disaggregated by sex, provide gender sensitivity training as part of capacity building, and prioritize gender-informed proposals in competitively financed activities. Women from underrepresented communities (e.g., Afro-Peruvian and Indigenous) are encouraged to participate.
- In **Argentina**, the Improving Inclusion in Secondary and Higher Education (P168911) aims to reduce educational exclusion and dropout rates in basic and higher education among the most vulnerable students and to improve learning trajectories in the country. One of the project sub-components aims to increase the percentage of female scholars in higher education that study STEM.
- In **Mexico**, the Additional Financing for Energy Efficiency in Public Facilities Project (P165585) supports a "Women in STEM" program that mentors young women in public high schools to increase their interest in science and engineering.
- In **St. Lucia,** the Renewable Energy Sector Development Project (P161316) encourages more women in technical jobs within the energy sector. Some of the key project strategies include an annual scholarship program for women to pursue electrical or mechanical engineering degrees; an extended 3- to 9-month apprenticeships for women enrolled in the electrical and mechanical engineering programs; outreach programs in secondary schools to inform soon-to-be graduates of educational and employment opportunities in the engineering and energy sectors; and annual job fairs to support its graduates in finding jobs in the energy sector.

RELEVANT RESOURCES

WORLD BANK RESEARCH ON THE TOPIC

Avitabile, C. and de Hoyos, R. 2018. The Heterogeneous effect of information on student performance: evidence from a randomized control trial in Mexico. Policy Research Working Paper 7422. Washington, DC: World Bank.

Hammond, Alicia; Rubiano-Matulevich, Eliana; Beegle, Kathleen; Kumaraswamy, Sai Krishna. 2020. The Equality Equation: Advancing the Participation of Women and Girls in STEM. Washington, DC: World Bank.

Schomer,Inka Ivette; Hammond,Alicia Samantha. 2020. Stepping Up Women's STEM Careers in Infrastructure: An Overview of Promising Approaches Volume 1. Washington, D.C.: World Bank.

OTHER KEY RESEARCH

Agurto, M., Bazan, M., Hari, S., and Sarangi, S. 2021. Women in Engineering: The Role of Role models. GLO Discussion

Paper, No. 975, Global Labor Organization, Essen.

IADB Lab. 2019. wX Insights 2020: The Rise of Women STEMpreneurs: A Study on Women Entrepreneurs in STEM in Latin America and the Caribbean. Washington DC: IADB.

García-Holgado, A., Verdugo-Castro, S., Sánchez-Gómez, M.C., García-Peñalvo, F.J. 2020. Facilitating Access to the Role Models of Women in STEM: W-STEM Mobile App. In: Zaphiris, P., Ioannou, A. (eds) "Learning and Collaboration Technologies. Designing, Developing and Deploying Learning Experiences." HCII 2020. Lecture Notes in Computer Science, vol 12205. Springer, Cham.

López-Bassols, Vladimir; Grazzi, Matteo; Guillard, Charlotte; Salazar, Mónica, 2018. Las brechas de género en ciencia, tecnología e innovación en América Latina y el Caribe: Resultados de una recolección piloto y propuesta metodológica para la medición. Washington DC: Inter-American Development Bank.

UN Women, 2020. Las mujeres en ciencias, tecnología, ingeniería y matemáticas en América Latina y el Caribe. UN Women: Uruguay.

UNESCO, 2022. An unbalanced equation: Increasing participation of women in STEM in Latin America and the Caribbean. UNESCO: Paris.

United Nations Children's Fund, ITU, 2020. Towards an equal future: Reimagining girls' education through STEM, UNICEF: New York.

UNICEF, 2020. Mapping gender equality in STEM from school to work. UNICEF: New York.

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

GENDER STATISTICS, INDICES, AND MEASUREMENT TOOLS

- IDB Gender Portal
- OECD Social Institutions and Gender Index
- UNDP Human Development Gender Inequality Index
- UNDP Human Development Gender Development Index
- UIS Database
- UN Women
- UNESCO Institute for Statistics
- World Economic Forum Global Gender Gap Report (2022)
- World Bank Gender Data Portal
- World Bank World Development Indicators
- World Bank Women Business and the Law
- World Bank Global Findex
- World Bank Group Enterprise Survey

REFERENCES

Agurto, M., Bazan, M., Hari, S., and Sarangi, S. 2021. Women in Engineering: The Role of Role models. GLO Discussion Paper, No. 975, Global Labor Organization, Essen.

Avitabile, C. and de Hoyos, R. 2018. The Heterogeneous effect of information on student performance: evidence from a randomized control trial in Mexico. Journal of Development Economics 135: 318-348.

Breda, T., Grenet, J., Monnet, M., and Effenterre, C. 2018. "Can female role models reduce the gender gap in science? Evidence from classroom interventions in French high schools," in PSE Working Papers halshs-01713068. Paris: HAL.

Cano, S. A Methodological Approach to Teaching STEM Skills in Latin America through Educational Robotics for School Teachers. 2022. Electronics 11(2): 395.

García-Holgado, A., Verdugo-Castro, S., Sánchez-Gómez, M.C., García-Peñalvo, F.J. 2020. Facilitating Access to the Role Models of Women in STEM: W-STEM Mobile App. In:

Zaphiris, P., Ioannou, A. (eds) "Learning and Collaboration Technologies. Designing, Developing and Deploying Learning Experiences." HCII 2020. Lecture Notes in Computer Science, vol 12205. Springer, Cham.

Hammond, A., Rubiano-Matulevich, E., Beegle, K., and Kumaraswamy, S. K. 2020. The Equality Equation: Advancing the Participation of Women and Girls in STEM. Washington, DC: World Bank.

Harackiewicz, J. M., Rozek, C. S., Hulleman, C. S., and Hyde, J. S. 2012. Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science*. 23 (8): 899-906.

IADB Lab. 2019. wX Insights 2020: The Rise of Women STEMpreneurs: A Study on Women Entrepreneurs in STEM in Latin America and the Caribbean. Washington DC: IADB.

Ikkatai, Y., Inoue, A., Minamizaki, A., Kano, K., and Yokoyama, H. M. 2021. Effect of providing gender equality information on students' motivations to choose STEM.

López-Bassols, V., Grazzi, M., Guillard, C., and Salazar, M. 2018. Las brechas de género en ciencia, tecnología e innovación en América Latina y el Caribe: Resultados de una recolección piloto y propuesta metodológica para la medición. Washington DC: Inter-American Development Bank.

Mohr-Schroeder, M. J., Jackson, C., Miller, M., Walcott, B., Little, D. L., Speler, L., Schooler, W, and Schroeder, D. C. 2014. Developing middle school students' interests in STEM via summer learning experiences. School Science and Mathematics Vol. 144(6): 291-301.

Munoz Boudet, Ana Maria; Rodriguez Chamussy, Lourdes; Chiarella, Christina; Oral Savonitto, Isil. 2021. Women and STEM in Europe and Central Asia. World Bank, Washington, DC.

Sadler, P. M., Sonnert, G., Hazari, Z., and Tai, R. 2012. Stability and volatility of STEM career interest in high school: A gender study. Science Education 96 (3): 411-427. DOI: 10.1002/sce.21007.

Schomer, I. I. and Hammond, A.. 2020. Stepping Up Women's STEM Careers in Infrastructure: An Overview of Promising Approaches Volume 1 Washington, D.C.: World Bank.

Sosale, Shobhana; Harrison, Graham Mark; Tognatta, Namrata; Nakata, Shiro; Mukesh Gala, Priyal. 2023. Engendering Access to STEM Education and Careers in South Asia: Overview. South Asia Development Forum; Washington, DC: World Bank

UN Women, 2020. Las mujeres en ciencias, tecnología, ingeniería y matemáticas en América Latina y el Caribe. UN Women: Uruguay.

UNESCO, 2022. An unbalanced equation: Increasing participation of women in STEM in Latin America and the Caribbean. UNESCO: Paris.

United Nations Children's Fund, ITU, 2020. Towards an equal future: Reimagining girls' education through STEM, UNICEF: New York.

UNICEF, 2020. Mapping gender equality in STEM from school to work. UNICEF: New York.

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

United Nations Educational, Scientific and Cultural Organization (UNESCO). 2015. "UNESCO Science Report: Towards 2030." Paris: UNESCO.