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FORO ABIERTO DE CIENCIAS
LATINOAMÉRICA Y CARIBE

AN UNBALANCED EQUATION: INCREASING PARTICIPATION OF WOMEN IN STEM IN LAC

Alessandro Bello
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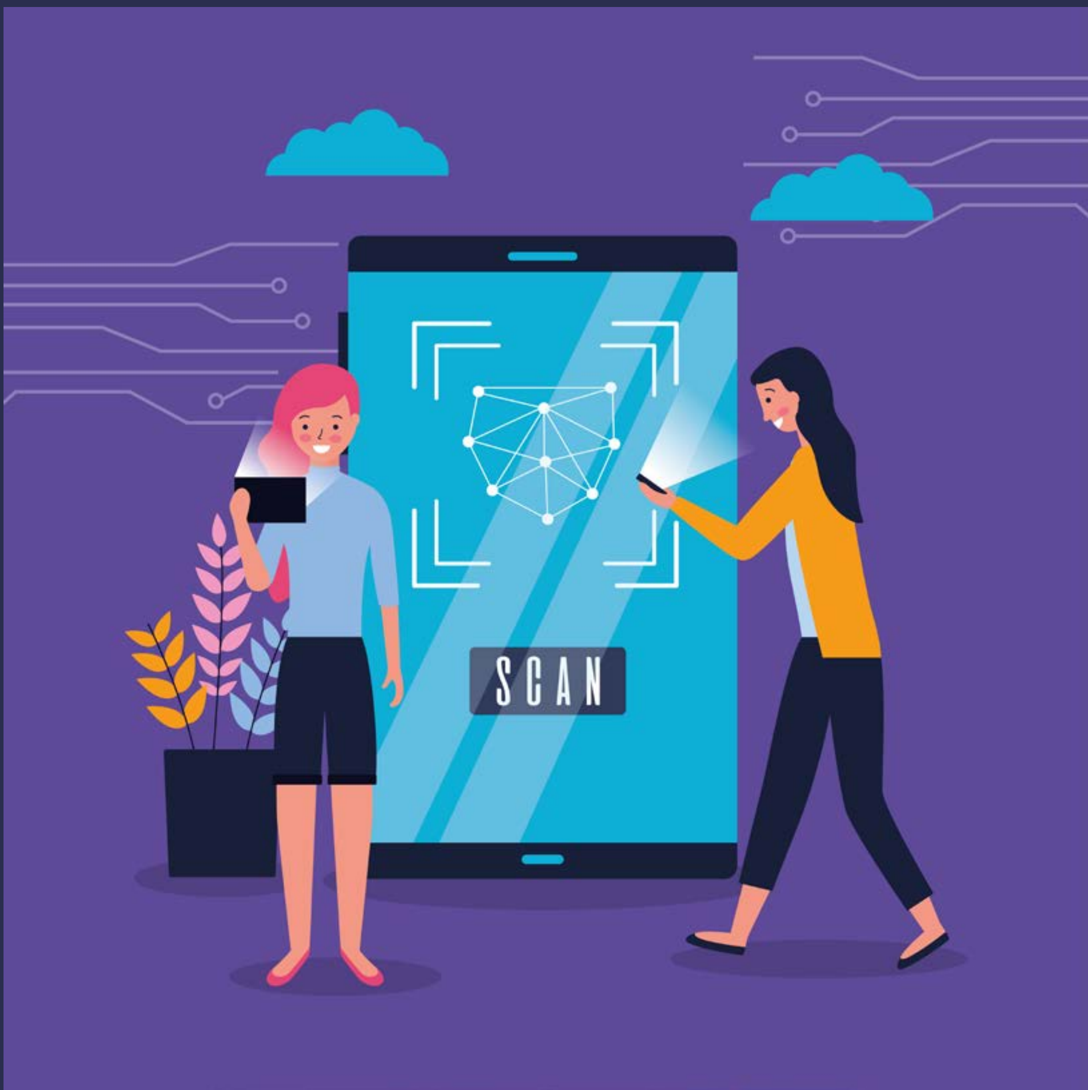

5 GENDER EQUALITY

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This paper sets out to describe the gender gap in STEM experienced by women. We acknowledge it is limited in its approach to gender due to lack of available data, being sex-disaggregated at best. We acknowledge the gap in available data to describe the experiences, challenges and levels of participation of Trans and non-binary people.

SCIENCE, TECHNOLOGY & INNOVATION AS CROSSCUTTING AXES OF THE GLOBAL SUSTAINABLE AND INCLUSIVE DEVELOPMENT AGENDA TOWARDS 2030

The Open Science Forum in Latin America and the Caribbean -CILAC- is conceived as a space that contributes to the implementation of the 2030 Agenda endorsed by the General Assembly of the United Nations. It is aimed at becoming a platform for reflection and interaction in relation to the issues of science, technology and innovation management. Therefore, for the consortium of CILAC organizing institutions, it is important that the debates and reflections are not limited to the organization of the Forums every two years, but kept alive over time.

UNESCO, as a specialized agency of the United Nations System, dedicates its efforts to the advancement of knowledge in five major fields that are vital for sustainable human development: education, natural sciences, social sciences and human rights, culture, and communication and information.

To fulfil this mission, UNESCO operates along five strategic axes: a) the definition of international standards (b) capacity building; (c) organization and dissemination of knowledge; (d) international cooperation; and (e) laboratory of ideas. Thus, the CILAC Forum constitutes a platform to enhance these strategies, strengthening science, technology and innovation policies in the countries of Latin America and the Caribbean.

These documents, which are prepared by renowned experts in their respective fields of knowledge, identify challenges and propose key ideas for moving forward. In their contributions, the authors describe innovative areas of knowledge and action, assess their potential for the future of the region - whether as an opportunity or a threat - and offer possible decision-making scenarios.

These contributions are not intended to be conclusive, but are mainly offered as an invitation from UNESCO to all stakeholders so that, together and without ignoring diversities or divergences, we can advance the public debate on the role to be played by science, technology and innovation in the present and future of Latin America and the Caribbean.

Building sustainable, democratic, and inclusive knowledge societies with broad human rights protection is an urgent and necessary task. The spirit of the texts we publish today is to enrich these debates, promoting their continuity in the time to come. We do so with the conviction that these efforts are essential in order to advance the regional agenda, with a view to the implementation of the Sustainable Development Goals. Because connecting to a desirable future, requires connecting to science.

Good reading! Good debates!

Lidia Brito,

Director
Regional Bureau for Sciences in
Latin America and the Caribbean - UNESCO

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Authors and acknowledgements

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ACRONYMS

AI - Artificial Intelligence

ECLAC - United Nations Economic Commission for Latin America and the Caribbean

EIGE - European Institute for Gender Equality

EU - European Union

FTE Full-Time Equivalent

GDP - Gross Domestic Product

GBV – Gender-based violence

HC - Headcount

HDI - Human Development Index

HE - Higher Education

IDB - Inter-American Development Bank

IANAS- Inter-American Network of Academies of Science

ICT - Information and Communication Technologies

IDRC - International Development Research Centre

INDICES - Red Iberoamericana de Indicadores de Educación Superior

IP - Intellectual Property

ISCED - International Standard Classification of Education

LAC - Latin America and the Caribbean

NGO - Non-governmental organisation

OAS - Organization of American States

OECD - Organisation for Economic Co-operation and Development

OEI -Organization of Ibero-American States

PISA - Programme for International Student Assessment

R&D - Research and Development

RICYT - Red de Indicadores de Ciencia y Tecnología - Iberoamericana e Interamericana

S&T - Science and Technology

SAGA - STEM and Gender Advancement

STEM - Science, Technology, Engineering and Mathematics

STEAM- Science, Technology, Engineering, Arts and Mathematics

STI - Science, Technology and Innovation

SDGs - Sustainable Development Goals

UN - United Nations

UNDP - United Nations Development Program

UNESCO - United Nations Educational Scientific and Cultural Organization

UN Women - United Nations Entity for Gender Equality and the Empowerment of Women

UIS - UNESCO Institute for Statistics

WEF - World Economic Forum

WISE - Women in STEM and Entrepreneurship

FOREWORD

Despite gender equality being enshrined in international law since 1948 as part of the Universal Declaration of Human Rights, despite decades of advocacy and a UN Sustainable Development Goal, SDG5, being dedicated to it specifically, gender equality remains "the unfinished business of our time" (United Nations 2021). While there has been some progress over the decades, women in the labour market still earn on average 20 per cent less than men globally (United Nations 2021).

Within the context of Higher Education, despite improved access at undergraduate and postgraduate level over the last few years, women are far less likely to progress beyond Master's level graduation or into research fields: globally, 71% of university researchers are male (UNESCO, 2020). Within STEM fields, this disparity is even more marked. Only 3% of scientific Nobel prizes have been awarded to women, and closer to home in Brazil, the representation of women in the highest positions in Science and Technology is between 0% and 2%.

Through our work building connections, understanding and long-term trust between people in the UK and other countries through education, the arts and English language, the British Council is placing particular emphasis on gender equality.

In the area of Women and Girls in STEM, we have established programmes which take a life cycle approach, from inspiring young girls to take up and stay in STEM, to supporting women working in STEM fields to network with their peers in their region and the UK, and running mentorship programmes to support career progression. This life cycle approach is one that you'll find reflected in this Policy Brief. To date we've engaged with more than 14,000 women researchers, academic staff and students, and reached over 20 million through our campaign for the Women in STEM Scholarships, through which 48 women were awarded a full bursary to study for a Master's degree from one of 8 UK universities in England, Scotland or Wales.

In 2020, we commissioned our partner Technopolis to conduct an in-depth study on the context of Women and Girls in STEM from across Latin America and the Caribbean (LAC) by reviewing and pulling together existing research and data into one single report. This Policy Brief summarises the key findings of that research, and our intention is for it to highlight both the achievements and ongoing challenges faced by governments, education institutions and organisations in LAC in terms of achieving gender equality in STEM.

We hope it serves as an invitation for knowledge exchange and debate and facilitates mutual learning, both within LAC and with the UK, and that together we can explore how values of equality can be reflected in policy and put into practice to improve outcomes for women and girls across our region, and indeed the world.

Helen Silvester

Regional Director - Americas
British Council

EXECUTIVE SUMMARY

In our changing technological world, Science, Technology, Engineering and Mathematics (STEM) are often referred to as the jobs of the future, driving innovation, social wellbeing, inclusive growth, and sustainable development. But it is estimated that only one woman secures a job in STEM fields for every four men, contributing towards greater economic inequality in society. Despite efforts to bridge gender gaps in STEM areas, voids still exist at different levels of education and career progression in almost every country around the world. These gaps can be observed at all life cycle stages, from primary school to workplaces and leadership positions.

As a result of various policies and activities implemented at different levels over the last 20 years, Latin America, and the Caribbean (LAC) region have experienced some improvements regarding the inclusion of women in science. Now, the region is one of just two globally that have achieved parity in the share of female and male researchers overall. However, even though female participation has been increasing, inequalities remain in several countries and in certain disciplinary sectors, which affect the access to STEM for girls, and the recognition of women's work in science and their ability to rise to positions of leadership.

There are several complex factors that lead to the unequal outcomes for men and women in STEM, which are not easy to address. At basic and secondary education level, there is a substantial lack of awareness among young generations of the potentials of STEM studies, reinforced by a lack of gender-responsive STEM pedagogies, tools and infrastructures that affect most schools and impacts on teachers' capabilities to make STEM studies more appealing to girls. Gender prejudices perpetuated in families, schools and media generate an stereotyped representation of masculine and feminine best educational options and tend to discourage girls to specialize in STEM. Prejudices persist across professional cycles and affect the career development of female researchers and professionals working in R&D systems and enterprises.

Over the last decade, different actors in the region, ranging from Governmental institutions, universities and research centres to civil society and international agencies, as well as private companie,s have launched different types of initiatives aimed at reducing the gender gap in STEM. Some actors within this complex ecosystem have also started acting together to increase the inter-institutional linkages and coordinated efforts needed to address a topic that requires a holistic approach. In many LAC countries, actions initially targeted the retention of women in STEM studies and jobs. Recently, efforts have also been directed at raising the visibility of women's scientific achievements and connecting them through regional and national networks. There are significant divergences among countries in terms of the presence of those action and their efficacy. Gender mainstreaming in STEM is strongly related to the overall linkage of factors like: the maturity of the STI system in a country, the size of its S&T workforce, its history, the political and cultural background, and the institutional framework.

Among the contextual factors at play, beyond societal misconceptions and persistent, harmful stereotypes, some may point at the lack of specific policies for gender equality in STEM. Sporadic and time-limited activities, limited budgets and weak STEM focus are some of the negative features of the interventions implemented to date. Moreover, these initiatives are also failing at including rural women, parents, teachers, and men. One of the main problems with the existing initiatives is the lack of information (evaluation) about their results and outcome, as well as information about their success in achieving their objectives. Many initiatives were ambitious in the initial phase of implementation, but not necessarily successful in reaching their results and in having any impact. It is important to learn from good practices and successful elements, but we must also learn from what has not worked to avoid repeating the same mistakes. This requires, nevertheless, transparency from actors implementing these initiatives, as well as robust and honest evaluations.

1. INTRODUCTION - SETTING THE GLOBAL CONTEXT

In the past two years, the world has gone through a fundamental transformation which has changed the way we live, work, and think, and which shows no signs of abating. This has had resounding implications for women's participation at all levels of education, scientific research, and practice (Bello, Blowers y Schneegans 2021).

There are unprecedented global challenges such as the COVID-19 pandemic and the ever more extreme, tangible effects, of climate change along with their consequent impact on food security, shelter, sanitation, and health. Yet we have also seen an abundance of opportunities offered by what has been termed the 'fourth industrial revolution', including technological advances, machine learning and artificial intelligence, not to mention the response by the scientific community to COVID-19.

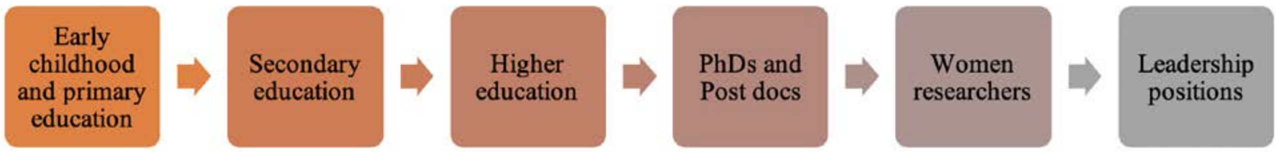
Science, Technology, Engineering and Mathematics (STEM) are responding to the changing technological world and are often referred to as the jobs of the future, driving innovation, social wellbeing, inclusive growth, and sustainable development. Predictions emphasise that future jobs will require STEM and ICT skills, with several sources anticipating that these skills will be required for approximately 75% of jobs (EQUALS and UNESCO 2019).

But there are multiple barriers which lead to a lack of willingness or opportunity for girls to choose a career in STEM. For this reason, it is estimated (WEF 2016) that only one woman secures a job in STEM fields for every four men, contributing towards greater economic inequality in society. In advanced digital technologies, the proportions of women are particularly low. For example, in the worldwide Artificial Intelligence (AI) sector, only 22% of total professionals are women. (WEF 2018) This gap is visible in all the top 20 countries with the highest concentration of AI employees. According to WEF for the three LAC countries present in this group, the gap is still worse. It is also estimated that among machine learning researchers, the share of women is only 12% (Bello, Blowers and Schneegans 2021).

As AI and advanced digital technologies are changing the way people live, produce and work and are key factors in future jobs, women must not be left out. Women have a critical stake in participating in the digital economy to ensure that Industry 4.0 does not perpetuate, or worse, exacerbate the gender biases that have historically existed.

Despite efforts to bridge gender gaps in STEM areas, voids still exist at different levels of education and career progression in almost every country around the world (Bello, Blowers and Schneegans 2021). These gaps can be observed at all life cycle stages, from primary school to women in high positions in STEM careers (A. Bello

Figure 1. Life cycle stages



2020). According to data from the last UNESCO Science Report (USR) and from UNESCO Institute for Statistics (UIS), in 2020 the global average percentage of women researchers was 33%, while at the national level, just under a third of countries achieved what is classed as "gender parity" (with women making up 45%-55% of researchers). This gap is even wider in within some STEM fields.

There are several complex factors that lead to the unequal outcomes for men and women in STEM and are present at different levels of the life cycle (see Figure 1). Consequently, they are not easy to address. Moreover, gender prejudices that are perpetuated in families, educational communities, and workplaces, are one of the most present factors along all life cycle stages. Economic, cultural, social, and religious contexts intersect on these processes, generating gaps that can become chronic and reinforce economic and social differences (UN Women 2020).

There are many positive reasons for promoting gender equality in STEM along all life cycle stages.

- First and foremost, there is the rights-based, or social justice argument. Gender equality and access to science are recognised as human rights by the Universal Declaration of Human Rights (art. 2 and art. 27).

- Through STEM education, students are prepared for the job market of the future as well as to make a workforce Industry 4.0-ready. Therefore, there is a need to develop STEM capabilities for the future needs by aligning educational curricula with industry relevant skills. According to a recent collaborative study across 29 United Nations programmes, it was envisaged that more than 7.1 million jobs will be displaced by 2020, and that half of currently existing jobs will disappear by 2050 (World Economic Forum 2018). More than 60% of children entering primary school today could eventually end up working in jobs that do not yet exist and many of these new jobs will be based on STEM. It is vital that girls and women get equal access to the emerging workplace of the future.

- Promoting STEM education for girls and young women will help close the gap in the existing STEM workforce, which will bring about wider societal benefits. Closing the gender gaps in STEM education would lead to an increase in European Union (EU) GDP per capita by 2.2% - 3.0%, and the creation of between 850,000 and 1,200,000 jobs by 2050 (European Institute for Gender Equality-EIGE 2017). We must also consider that a typical STEM worker earns two-thirds more than non-STEM workers (Funk y Parker 2018) thus, achieving gender equality in STEM becomes a strategy to support lifting entire families out of poverty.

- Women as a diverse group bring a rich variety of experiences and perspectives that are invaluable and contribute to better quality in science and innovation. A study of 2.5 million scientific publications suggests that those authored by teams of researchers with greater ethnic diversity receive more citations than papers co-authored by individuals with similar backgrounds (Freeman 2014). Moreover, scientific output can be more valuable to society if the teams of researchers reflect the diversity within our societies. Diversity in science contributes to new and expanded learner cohorts, alternative voices, narratives, teaching strategies, curricula and methodologies which influence not only the scientist but enhance the outputs and outcomes of science, benefitting all of society. Achieving gender equality in STEM is not just about numbers, nor is gender equality only relevant to women: gender concerns the cultural practices and expectations (often though not always reflected in policies) that govern men and women's expected, endorsed and actual behaviour.

- Reaching gender equality in STEM would also benefit scientific productivity. A recent study from the Inter-American Development Bank (IDB 2017) shows that by eliminating gender inequality in the promotion to high academic degrees in Mexico, the national academic system would benefit from an increase in scientific productivity (number of articles published in peer-reviewed journals) of between 17% and 20%.

- Sustainable development requires more science and more scientists, and therefore gender equality in STEM is also key for achieving each one of the 17 Sustainable Development Goals (SDGs) of the UN 2030 Agenda (UNESCO 2018).

Latin America and the Caribbean (LAC) is one of the two regions, along with Central Asia, that has achieved parity in the share of female and male researchers overall. (UN Women 2020) However, numbers can be deceiving, and this paper will explore the many challenges women face across LAC when pursuing a career in STEM as well as in reaching higher and leadership positions (horizontal and vertical segregations).

Box 1. General factors hampering girls and women taking up careers

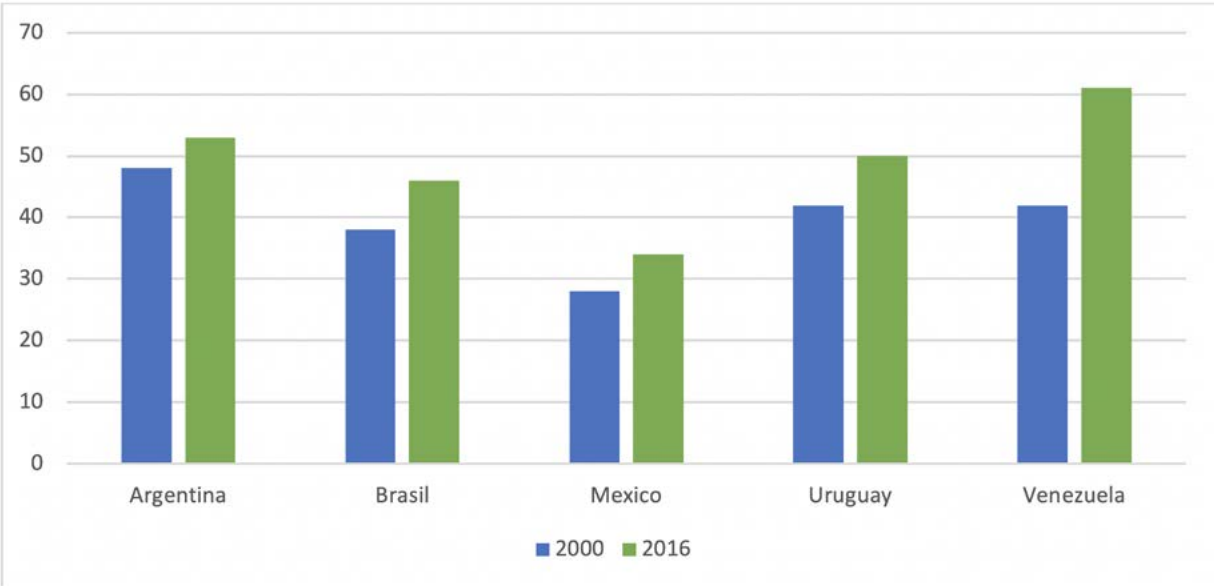
- Lack of awareness among young generations, particularly girls, of the potentials of STEM studies.
- Overall misunderstanding across society of the STEM careers themselves, which tend to be considered more difficult and harder than other studies and professions, such as those related to social sciences.
- Lack of gender-STEM pedagogy and tools, as well as infrastructure, which affect most public and private schools, especially those located far from urban and cultural centers.
- Persistent poverty and high socio-economic inequality among intra-national regions affect social access to TICs resources (digital competences, communication infrastructures and computational appliances). Girls and woman tend to be more affected by poverty than the overall population.
- Intersectionality factors - interplay of gender with race, LGBTIQ+ identity, and class affects girls and women in different ways, increasing levels of discrimination starting in the classroom and continuing throughout academic careers.
- Sexism in society, and particularly in academia, is a serious issue hampering the progression of women students and academics in STEM disciplines and affecting the access to senior and leadership positions.
- Low level of digitalisation across students and the society, which contributes to the gap in uptake of STEM careers between boys and girls and change stereotypes about STEM careers themselves.
- Lack of women role models to change stereotypes and increase interest in STEM, particularly among the youngest.

Source: own elaboration based on bibliographic review

2. GENDER AND SCIENCE IN LATIN AMERICA AND THE CARIBBEAN THROUGHOUT THE LIFE CYCLE

As a result of various policies and activities implemented at different levels over the last 20 years, countries in the LAC region have experienced some improvements regarding the inclusion of women in science, at different stages of the life cycle. Early studies in LAC (Estébanez 2004) showed by 2000 an average of 40 % of female researchers in five countries for regional R&D capabilities. By 2016 the average for the same group was 49% (RICYT 2021); (CNPQ 2016). Currently, LAC is one of the two regions in the world that achieved parity among researchers (UN Women 2020).

Figure 2. Evolution of female participation in total researchers 2000-2016



(Source: Estébanez 2004; CNPQ 2016; RICYT 2021)

In recent years greater attention was paid to map the empirical situation of gender equality through the production of specific studies about the absence and invisibility of women in science, and the application of gender perspective to STI indicators, such as the UNESCO SAGA project or the studies conducted by IDB (IDB 2017) and UN Women (UN Women 2020), among others.

However, even though female participation has been increasing, inequalities remain in several countries and in certain disciplinary sectors, which affect the access to STEM for girls, and the recognition of women's work in science and their ability to rise to positions of leadership (see section 2.4). The region also presents an heterogenous setting. In some counties more than in others, the path to gender equality in academic and research careers, particularly in STEM, still need to be fully walked. As a general feature, even within the same country, there are several differences among regions, and huge discrepancies between rural and urban areas.

The sections below describe the gender gap throughout the life cycle across LAC.

2.1. Early childhood and primary education

Girls' exclusion from education begins early and increases throughout their lives. All over the world in developing countries, around 125 million girls of primary and secondary age are out of school (UNICEF 2020).

In LAC a high proportion of girls and boys attend elementary education, but differences in terms of disciplinary performance appear early and throughout primary education. In stark contrast to the performance of girls in many other parts of the world, fewer girls than boys are achieving minimum proficiency levels in math at the upper primary level in most countries in Latin America (10 out of 12) (UNICEF 2020).

Several studies have pointed out the scope of the problem. The *Tercer Estudio Regional Comparativo y Explicativo* - TERCE (UNESCO 2016) has shown that regionally girls do better on reading tests while boys do better in maths; a phenomenon that increases as children progress through primary education and onto secondary (UN Women 2020). For instance, in Brazil, in the fourth grade, boys score 195.6 points in maths and girls 194.1, with only 1.5 points difference, but in eighth grade, boys outperform girls in maths tests by 9.1 points (INEP 2009). In Argentina, the results of the 2016-17 *Aprender* test (maths and language) suggested that while at primary education girls and boy perform similarly, by secondary education 10% more girls than boys have difficulties reaching maths and language basic levels (Lotitto y Szenkman 2020).

These performance features should be linked to stereotyped socialization. During early primary socialisation at family places, children internalise gender social representations and norms that build their first perceptions about feminine and masculine roles in the social world. For example, the kind of toys, readings, movies they will choose; how dress or other cultural practices which are related to socially established gender roles. One frequent phenomenon is the weak emotional linkages and the lack of interest in technological games and elementary science interest amongst girls that grow up in social environments where those practices are considered masculine (González García y Pérez Sedeño 2002).

These stereotypes will induce a segregated bias that in turn will shape their relationship with school and educational choices. Moreover, girls are generally not encouraged or trained to perform in STEM-related fields in the same way as boys (UN Women 2020). However, recent studies are showing that cultural changes are already taking place in society, which could be reflected in the career choices of the next generation (Catedra Regional UNESCO Mujeres, Ciencia y Tecnología en LAC 2017).

The transition from primary to secondary school seems to be crucial in consolidating the students' mentality regarding field-specific ability beliefs (EU European Union 2020). It is indeed at secondary level where the main barriers for girl STEM enrolment consolidate.

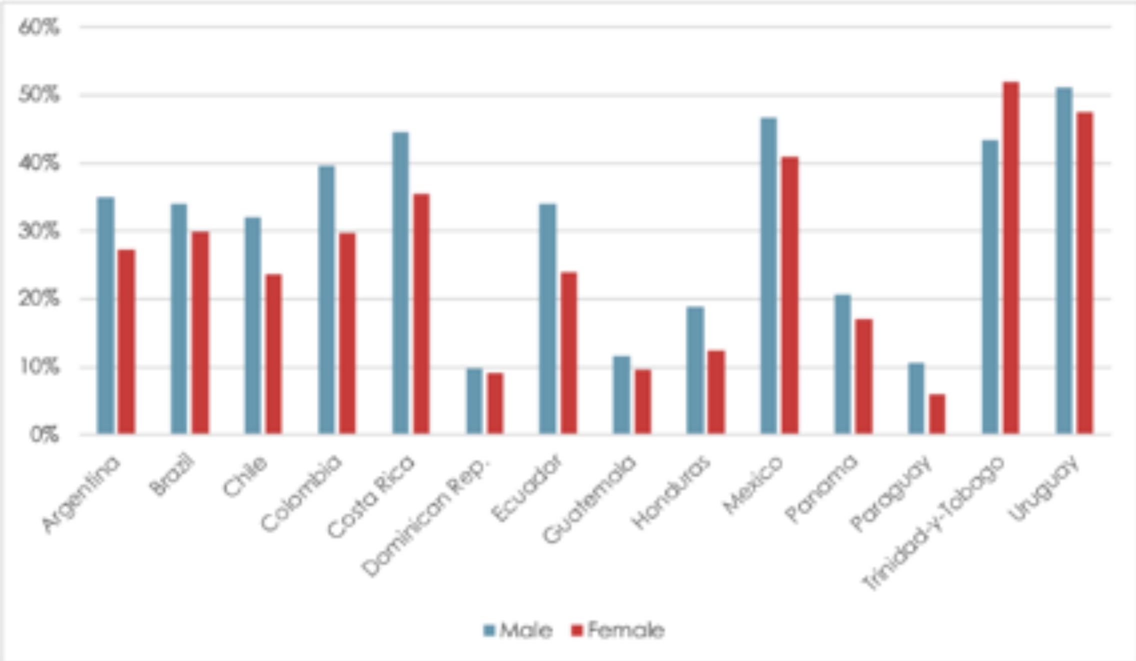
2.2. Secondary education

Both boys and girls show good levels of attendance in secondary education across LAC countries. According to UIS figures, there is a gender balance or a slightly high female participation than male at secondary studies. For example, the 2019 data, shows that four countries reach parity (Bolivia, Brazil, Chile, Colombia) while another other nine reach slightly higher female participation (UIS 2021).

However, the performance gender gap only deepens. There is a difference in the mathematics skills of boys and girls, as illustrated by the share of pupils having reached at least the minimum threshold of competence in this discipline (UIS, 2018) (see Figure 3).

Also, the PISA Test 2018 reported a difference in Mathematics and Science favouring boys over girls, above the OECD average, and typical across LAC countries. By the end of the lower level of secondary education, female pupils had reached a

Figure 3. Share of male and female pupils with the minimum math skills, 2018 (or latest available year)



Source: UIS (data consulted in September 2021)

lower proficiency in mathematics than the male fellows (OECD 2019).

The data also shows that one out of three students is interested in a science-related career, but that the expectations of future occupation are gender-biased already as teenagers: boys are on average twice as likely than girls to consider an engineering career. In some LAC countries (Colombia, Dominican Republic, and Mexico) this gap is particularly pronounced. An ICT-related career was considered by only 1% of girls, against 8% of boys (OECD 2019).

Social and academic environments may represent crucial barriers for girls to maintain their interest in STEM. Among the factors influencing girls' and women's participation, progression, and achievement in STEM education the most common explanations for inequalities include four main dimensions (UNESCO 2017): the student; family and peers; the school; and society.

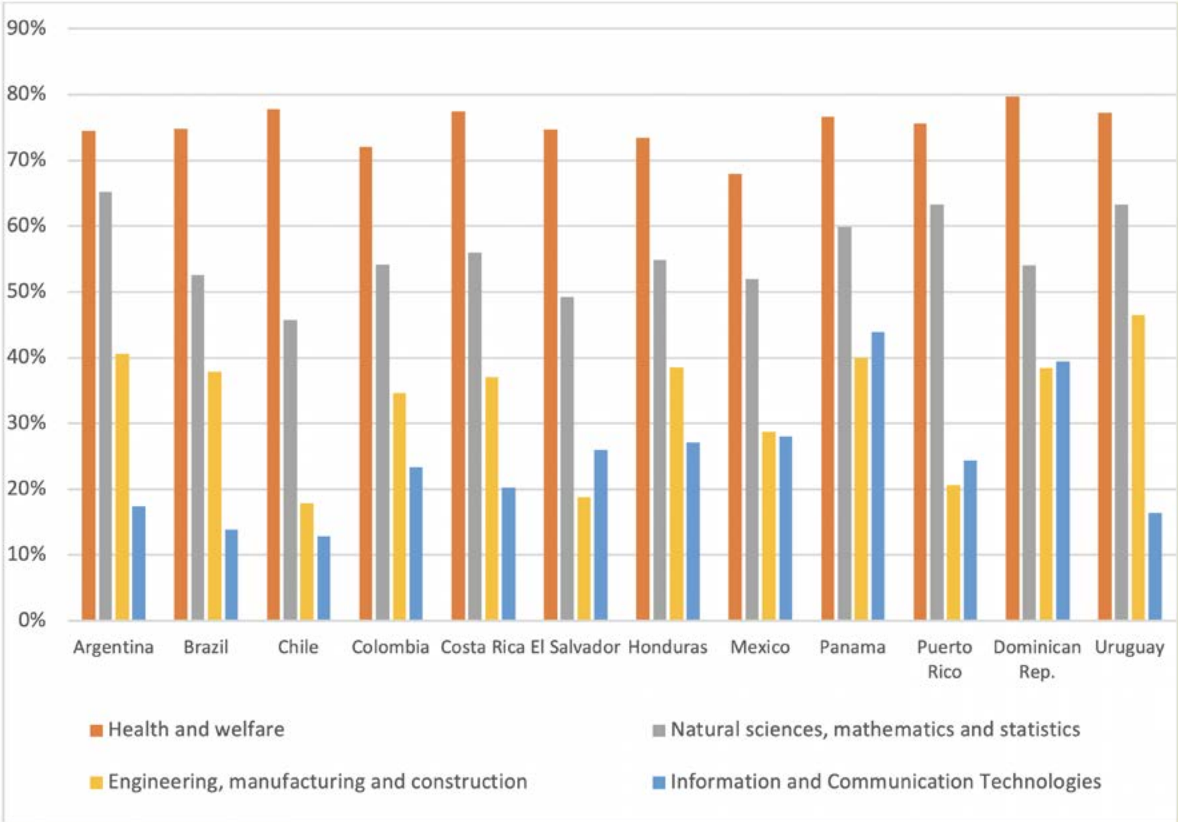
2.3. Higher education

In higher and further education, the underrepresentation of women in STEM and related fields appears as a strong feature. Stereotypes and social patterns are key influencers in career decisions and maintenance.

In LAC, academic engagement of women is oriented to the care industry and disciplines related with humanities. This trend is seen as a phenomena of horizontal segregation in tertiary studies by which women are concentrated into social sciences, humanities and life sciences (representing 70% of total students in Education and Health & welfare disciplines) while specific fields such as mathematics and statistics only have around 32% of female participation (except for Uruguay where women are overrepresented) (RICYT 2021) (Red Indices 2021).

This pattern is also evident among graduates and specially at the Ph.D. level. Globally, only 35% of all students enrolled in STEM-related fields are women (UNESCO 2018). In most LAC countries (with some few exceptions), women are also

Figure 4. Share of female students in tertiary education by field of study, 2018 (or latest available data)



Source: RICYT (data consulted in September 2021)

a minority and rarely exceed 40% among graduates in broad fields of engineering, industry, construction, information and communication technologies (where Chile notably only has 12% women graduates), and in agriculture and veterinary science (with the exception of Argentina with 62 %) (UIS 2021).

2.4. Research positions

In LAC, 46% of all researchers are women, a number far exceeding the global rate of 33%. (RICYT 2021). During the last ten years, this participation has showed an increasing trend, despite a relative stagnation at the end of the period.

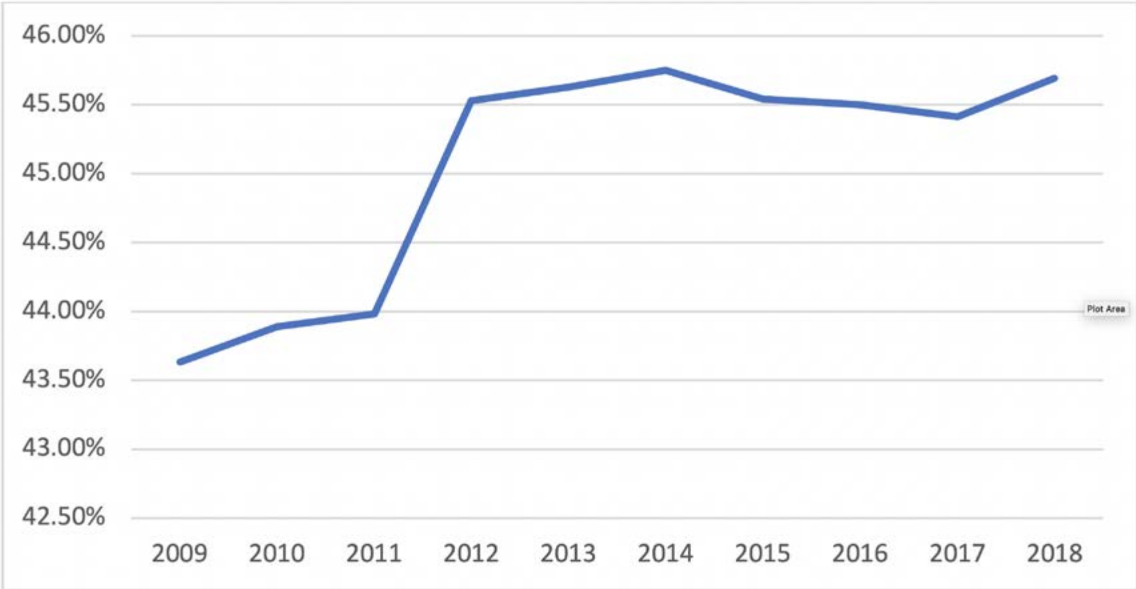
However, these achievements hide a more nuanced reality. Figure 6 illustrates the significant disparity among LAC countries in terms of female representation at R&D activities, ranging from less than a third in Peru and Mexico to more than parity in Trinidad and Tobago and Venezuela. Nine out of the 17 countries in focus (Argentina, Brazil, Costa Rica, Jamaica, Panama, Paraguay, Trinidad and Tobago, Uruguay and Venezuela) have reached gender parity (share comprised between 45% and 55%). (RICYT 2021).

Additionally, despite an increased presence among researchers, women still experience a strong glass-ceiling[1] effect that prevents them from reaching high seniority levels (vertical segregation) – a phenomena also known as the "leaky pipeline" (WIPO 2018).

First steps in gender segregation begin in the transit from university education to research positions. As shown in Figure 7, this pattern produces the "scissor effect": beginning with a high participation of women in postgraduate studies,

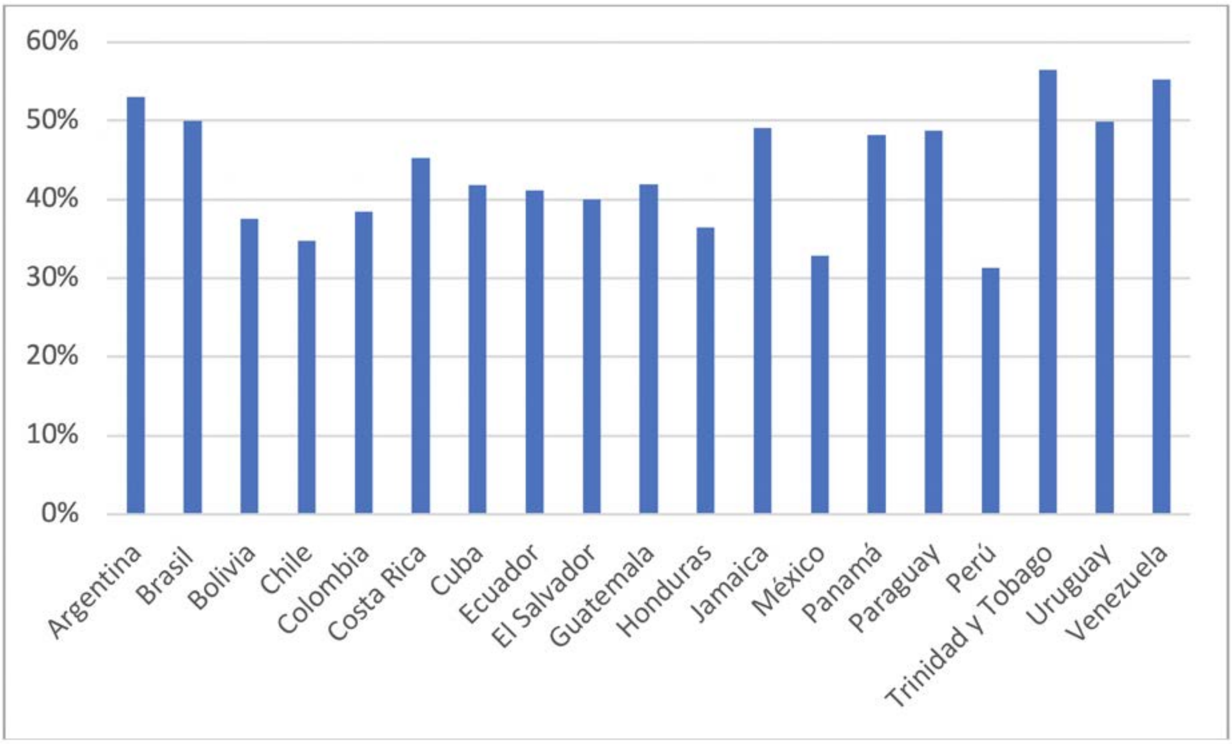
1 Glass-ceiling phenomena refers to invisible barriers that affect the advance of women in their careers, particularly their access to upper-level management.

Figure 5 Female researchers in LAC 2009-2018



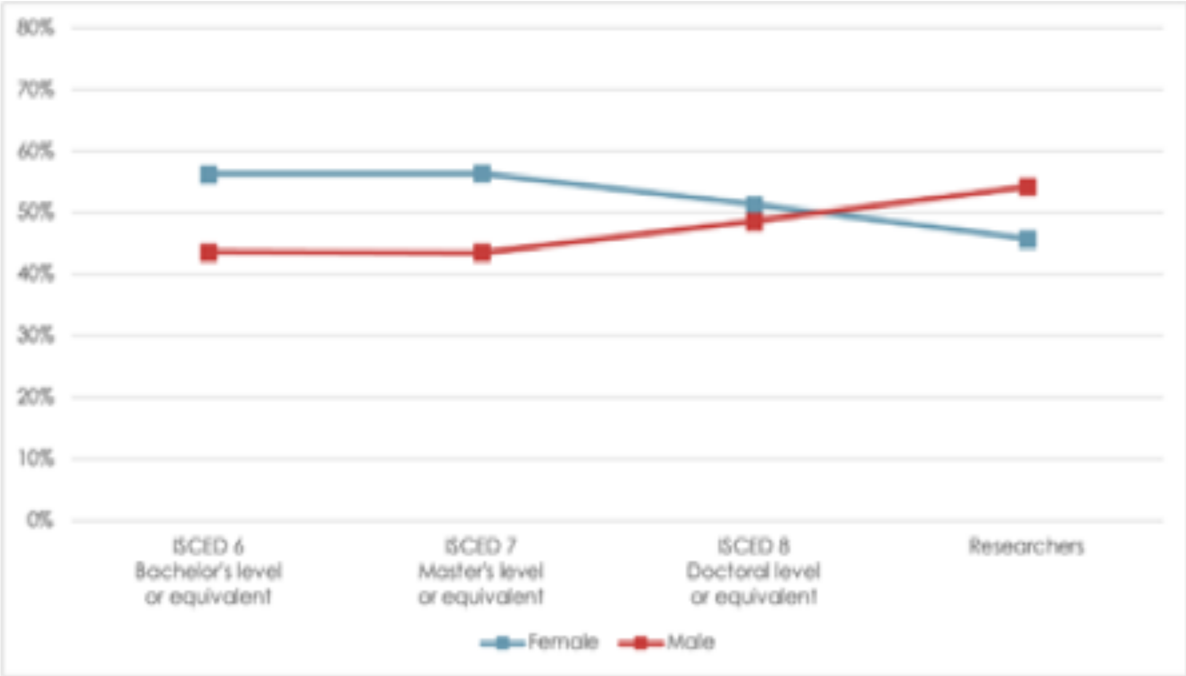
Source: RICYT (data consulted in September 2021)

Figure 6. Share of female researchers in LAC countries 2019 (or latest available data)



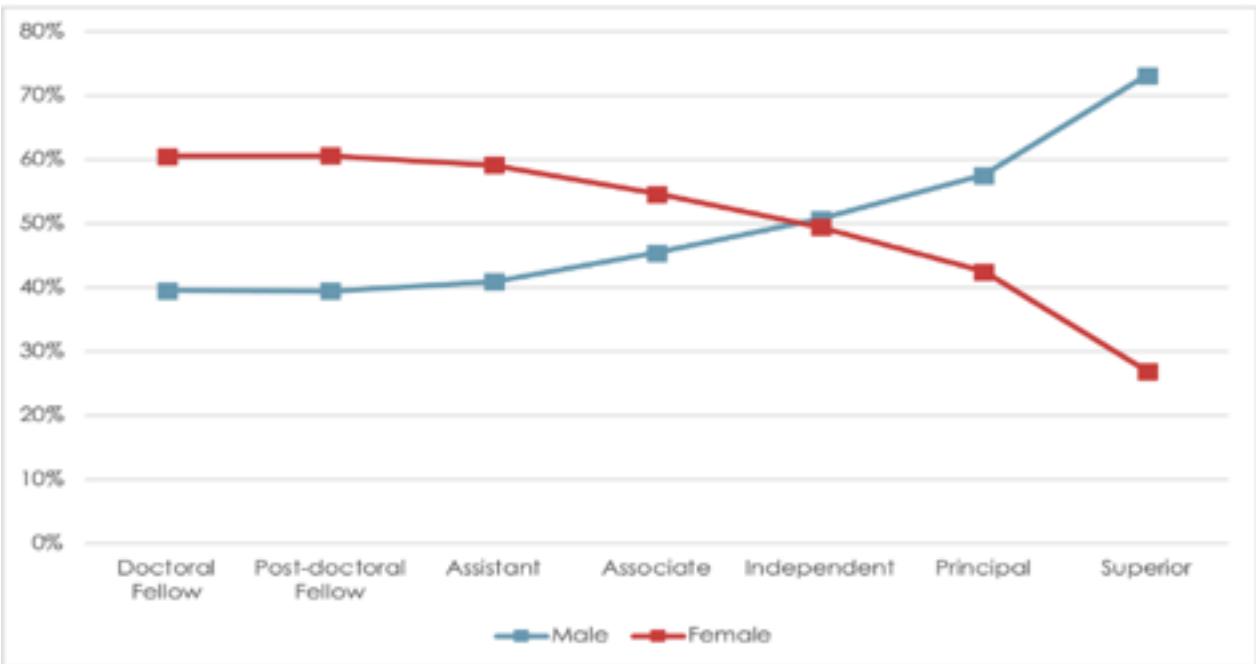
Source: RICYT (data consulted in September 2021); CNPq Diretório dos Grupos de Pesquisa, 2016

Figure 7 Share of female and male in tertiary education by program level and in research in LAC, 2019 (or latest available data)



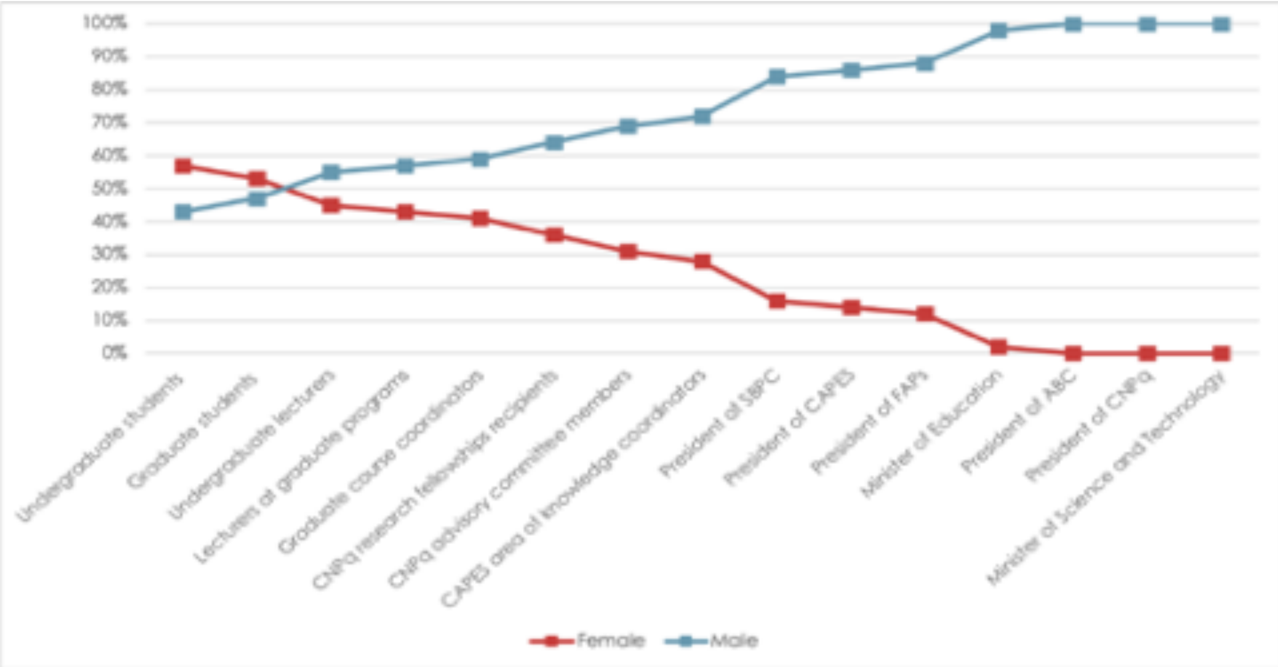
Source: own computations based on UIS (data consulted in September 2021)

Figure 8. Share of female and male researchers in Argentina in CONICET by seniority levels, 2018



Source: own computations based on (SICYTAR 2018)

Figure 9. Share of female and male in the Science and Technology ecosystem in Brazil by position



Source: (Areas, y otros 2020)

female presence decreases over the course of the scientific career, and the gender share is reversed when we reach the level of researcher.

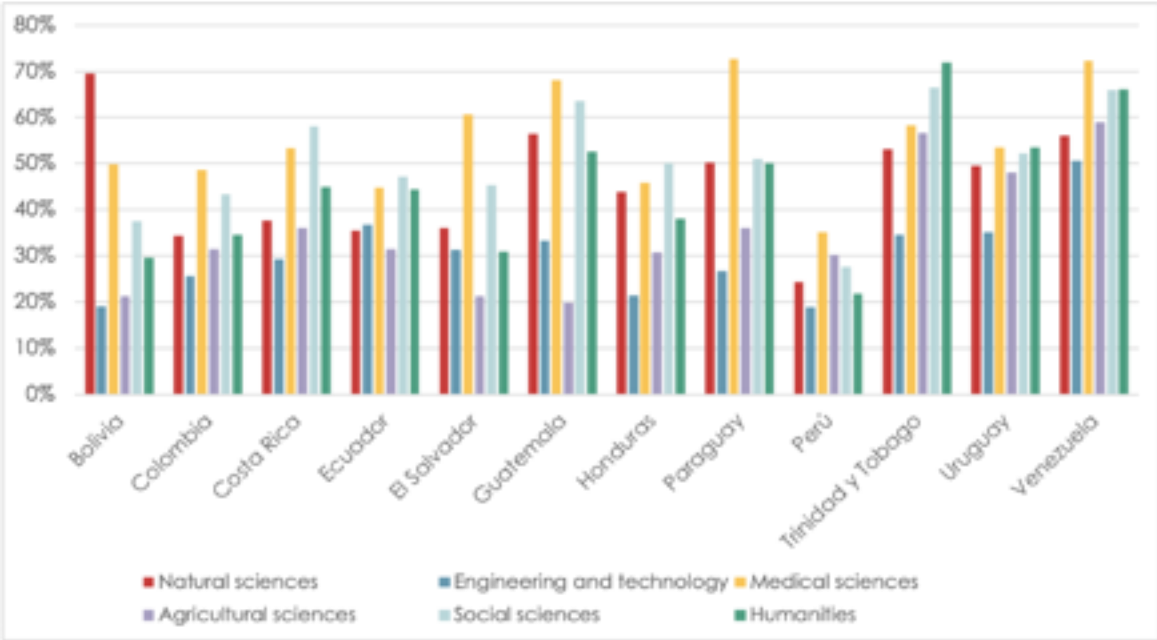
Due to numerous factors (explored in Section 3), this gender segregation persists throughout a woman's progress in her research career. LAC women are under-represented in upper academic and leadership positions and, in general terms, in any power space. In a similar way that stereotypes build STEM scientific career as masculine, power is also seen as a male competence.

Although data by seniority is available only for a few countries, and it is unreliable to compare seniority grades since they differ greatly among countries, the data available in two countries clearly shows this trend. Figure 8 and Figure 9 display this path for Argentina and Brazil.

Women are also underrepresented across research positions in STEM fields, a phenomenon known as horizontal segregation. Figure 10 shows that, according to the data of RICYT 2018, the percentage of women researchers working on engineering and technology topics in the region is much lower than that of men. In 2018, the share of female researchers working on engineering and technology topics was between 19% in Bolivia and Peru and 37% in Ecuador. Women are also still underrepresented in agricultural and veterinary science but tend to be overrepresented in research in medical and health sciences and in social sciences in most of the countries.

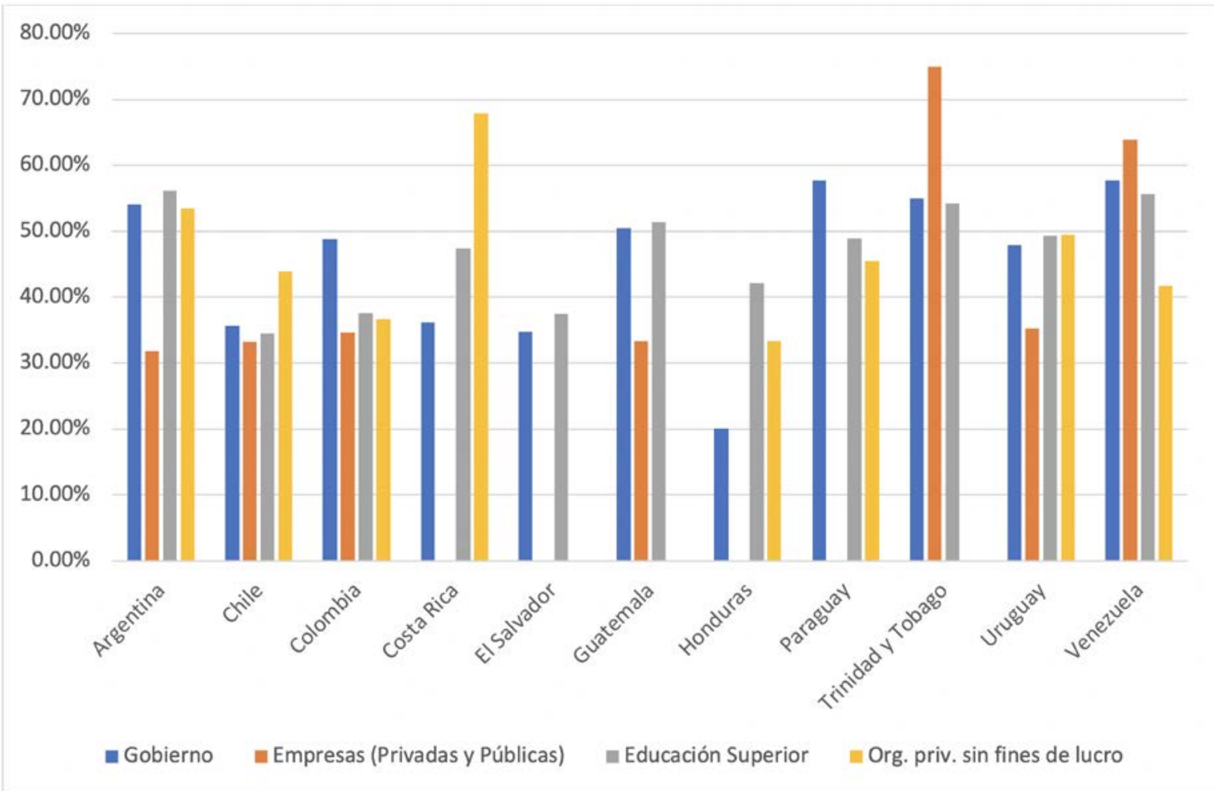
In summary, although the LAC region shows better results than the world average in terms of parity among researchers, there are still multiple barriers, such as cultural stereotypes and gender-based expectations, that prevent women from reaching the highest levels in research and affect their disciplinary choices. The gender parity is seen at the access level and in specific areas, mostly natural sciences, health, and others

Figure 10. Share of female researchers by field of study, 2018 (or latest available year)



Source: RICYT (data consulted in September 2021)

Figure 11. Situation of women researchers (FTE) in Latin America as % of total researchers according to the sector of work 2019, (or latest available year)



Source: RICYT (data consulted in September 2021) associated with the care industry, which obfuscates significant gaps, such as those in technology, engineering, and math's, which have a significant impact on access to high paid and influential fields such as AI, software development and advanced digital technologies.

While Figure 10 referred to the gender gap affecting R&D employment in government and Higher Education sector, the underrepresentation of women in research is even more pronounced in the enterprise sector. Indeed, the share of women researchers employed in this sector in five out of seven countries with available data -Argentina, Chile, Colombia, Guatemala, Uruguay- is less than 35% of researchers employed, as shown in Figure 11 (RICYT 2021).

2.5. Scientific and technological production

Around the world, women scientists publish less than their male counterparts (Liza Howe-Walsh y Turnbull 2016). A recent study analysing 2.87 million papers of computer science literature through 2018, shows that, if current trends continue, parity will not be reached before the year 2100, and this is according to the most optimistic projection models of the study (Wang , Stanovsky e Weihs 2019).

In LAC, the involvement of women in scientific production is very heterogeneous across the region. In particular, the share of scientific articles that include the participation of at least one female author ranks from 43% in El Salvador to 72% in Brazil. Following Brazil, the top countries are Argentina (67%) and Guatemala (66%), while the countries where the share is below 51% are Nicaragua, Chile, Bolivia, Ecuador, Costa Rica, Dominican Republic, and Honduras (OEI 2018). When looking at all the authors of scientific publications between 2014 and 2017, parity has been reached at the regional level as 46% of authors are women (OEI 2018).

Box 2. Science careers, gender and COVID-19

COVID-19 has broadly impacted the science community. Researchers are struggling to align the work of STEM investigators and limited access to laboratories and time-sensitive experiments. While more evidence is needed for an in-depth analysis of the effects of the COVID-19 pandemic on women in the STEM workforce, initial studies are already showing the amplification of challenges and barriers for women scientists.

A study from the Australian Academy of Science (AAS), show that job insecurity affects more women than men and could significantly set back recent gains towards gender equality in STEM fields (Australian Government 2020). The high proportions of women employed on short-term contracts and the fact that women still tend to take on a greater share of domestic and caring responsibilities are at least partly to blame. In Mexico women take on 72% of domestic labour on average (INEGI 2019).

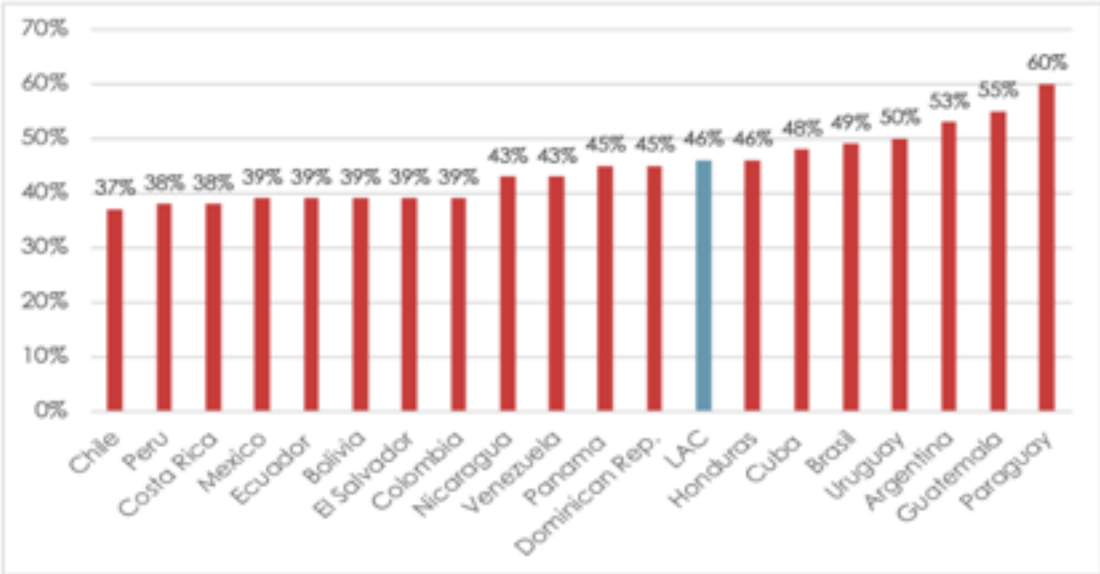
In another study (Than, Yin y Myers 2020)it was reported that female scientists from USA and Europe testified a 5% larger decline in research time than their male peers, reaching a 17% decline when they have at least one child five years old or younger. Reduction of work hours or unemployment for STEM women, will challenge the victories achieved for women scientists in the last decade.

In terms of publications, initial analyses suggest that women's publishing rates have fallen relative to men's amid the pandemic. Women are posting fewer preprints and starting fewer research projects than their male peers (Frederickson 2020)(M. Frederickson, 2020). Furthermore, in many countries, there was an amplification of male voices in the media and research institutions. In the UK, according to data gathered by the Expert Women Project (EWP) from the University of London, found an imbalance of 2.7 men for every female expert featured on the UK's flagship TV and radio news programmes on the political handling of the coronavirus outbreak across Britain.

As stated by the UN in the Policy Brief "The Impact of COVID-19 on Women" (April 2020)

"COVID-19 is not only a challenge for global health systems, but also a test of our human spirit. Recovery must lead to a more equal world that is more resilient to future crises".

Figure 12. Share of female authors in LAC countries, 2014-2017



Source: OEI (data consulted in September 2021)

Despite women's participation in scientific production, studies show that women are less likely than men to be first or last authors -more prestigious authorship positions- and that women-authored publications receive fewer citations. Also, the percentage of women listed as first and last authors is negatively associated with a journal's impact factor. In other words, the higher impact factor, the less female presence (Shen, Webster and Shoda 2018).

Compared to the proportion of scientific papers they publish each year, the proportion of women using the patent system is low. According to WIPO data, in LAC only a third of the international patent applications include at least one-woman inventor. Regarding the US patents filled by Latin American[2] assignees, only 22% are filled by women (Sifontes and Morales 2020). Moreover, the participation of women in the international patent system differs according to the fields. They are well represented in biotechnology (58% of the patents include at least one women inventor), pharmaceuticals (56%), and organic and food chemistry (55% and 51% respectively). In contrast, only 16% of patents related to machine tools, 15% to civil engineering and 14% to mechanical elements have at least one-woman inventor (WIPO 2018).

2 The countries considered in the study are Argentina, Brazil, Costa Rica, Chile, Cuba, Colombia, México, Panamá, Peru, Uruguay, and Venezuela.

BOX 3 : Availability of statistical information

Over the last 10 years, the collection of sex-disaggregated data has increased in Latin America, both in the area of science and technology and in higher education. Among the most visible examples is the work of the Ibero-American Network of Science and Technology Indicators (RICYT) and the Ibero-American Network of Higher Education Indicators (INDICES). They have been working together with the national bodies responsible for statistical production across the region to produce comparable indicators (RICYT 2021) (Red Indices 2021).

But up-to-date data on higher education and research and development (R&D) activities in the region is needed to analyse the current situation and trends in the gender gap in STEM. Moreover, as the results of the UNESCO SAGA Project have recently highlighted, there is a significant lack of sex-disaggregated data on gender equality in STEM, which hampers sound mapping of the needs and the development of better oriented initiatives and evidence-based policies.

This is not always an easy task, given that some countries still have an information bias that makes it difficult to fully comprehend the situation of women and to design specific policies founded in evidence. While most countries have the basic indicators (i.e number of R&D personnel and institutional sector by sex) the availability decreases as the level of detail and complexity of the data increases. This is particularly critical when looking at the specific fields that make up STEM.

The following table shows the percentage of Latin American countries reporting the five main gender indicators to RICYT over the last ten years, expressed in both individual's headcount (HC) and full-time equivalents (FTE) . The data is available at www.ricyt.org".

Regional coverage of science and gender indicators, 2021		
	HC	FTE
Female Staff	100%	71%
Researchers by employment sector	88%	65%
Researchers by scientific discipline	65%	47%
Researchers by training level	65%	53%
Researchers by age group	35%	24%

Source: own computations based on RICYT data

3. BARRIERS TO THE PARTICIPATION OF WOMEN IN STEM

3.1 Stereotypes

Gender stereotypes are among the factors that explain the gender segregation affecting women's integration into STEM studies and the negative incidence in retention and career advancement. Stereotypes take place at different instances of life cycle: childhood and the interplay with family and school socialization; youth vocational elections for university studies; and critical stages in decision-making process at scientific workplace. Even though those stereotypes appear to be less persistent among new generations, women remain affected by them (A. Bello 2020).

Families, communities, and educational institutions – the main brokering agents of broad cultural patterns – influence from very early stages study preferences and scientific and technological vocations. During primary socialisation children internalise gender representations and norms that build their first perceptions about feminine and masculine roles in the world. Because girls are less encouraged to perform in STEM-related subjects, gender bias appear already in early childhood (UNESCO 2018) and tend to discourage girls to specialise in STEM.

At primary and secondary school stage, teachers and institutions might keep reinforcing (consciously or not) that bias by assuming that some disciplines are more appropriate for girls and others for boys, and by applying gender-blind pedagogies which end up reproducing stereotypical behaviours and impacts. Girls and young women are seen as *"best prepared for caregiving and household tasks"* rather than for STEM fields.

Discipline choices are gendered in different ways by girls', boys' and non-binary people's preferences. Less attention of boys in so considered "feminine" studies is also a matter of gender stereotyping. And individual's intersectionality also contributes to educational choices. For this reason, actions intended to build equity should be oriented to all groups.

These types of horizontal gender segregation in education are widely acknowledged as one of the roots of gender segregation in science.

3.2 Obstacles to professional advancement

Career progression within STEM is a hard task and requires time and resource, for any person working in science. As part of the professional process, one is expected to get PhD credentials and recognised post-doc experience, to produce a significative amount of quality papers, to obtain fellowships abroad and other critical achievements required to be hired as researcher in a scientific institution and, eventually, to be promoted (European Commission 2012). Professional requirements imply almost exclusive dedication, high levels of geographical mobility and available time.

For women, once they obtain their first academic position, different types of obstacles affect specifically their advancement in the scientific profession. First, there are strong social expectations about the right moment to establish a family that influence decision-making, besides the biological clock determinants: at the so called "rush hour", women face biological childbearing decisions. The family-or-science dilemma discourages young women to get into scientific careers and produces early system dropouts acting as a filter. This problem is reinforced as there is not enough institutional support to assist women in the face of these challenges.

On the other hand, the definition of good science and best professional performance is associated with a complex set of factors, closely related, yet differentiated among disciplines, and of course linked with other broad problems related to science as a job in different contexts. The standards of scientific excellence that are translated into evaluation criteria can define scientific trajectories and impact strongly on promotion opportunities. Besides those universal rules that govern professional advancement, other factors are involved in the exercise of scientific profession. Some of them affect women and men equally, but others are highly gendered, often because a gender-blind approach is taken to their design.

For example, literature reviews show, as evidence of prevailing cultural stereotypes, that the quality of men's work is unconsciously better evaluated than women's work when reviewers are aware of the gender of the person to be evaluated, but not when the gender is unknown (European Commission, 2012).

Due to what is known as "peripheral science" (Diaz y Vessuri 1983) scientific excellence can be expressed in Latin America in other forms than global standards usually applied to STEM research evaluation. Many research topics, socially relevant to local needs, may not be considered issues of relevance according to global scientometrics trends. This is also the case for technical tasks, often related to applied science, that are linked to external demands or extension activities. Because of gender discrimination practices, women are more likely to oversee these kinds of tasks in the research workplace and/or attending to issues of local relevance in research projects. These complex factors might of course affect men and women working in different countries. In the end they are part of a stratification process strongly related to the sexual division of labour which reinforce gender bias to a differentiated degree.

These examples are part of the multiple barriers that affect women's advancement in scientific careers, widely described in the gender literature by metaphors like the '*leaky pipeline*', '*Sticky Floor*' and '*Glass Ceiling*'. These barriers hold back woman researchers, keeping them in lower positions, even in the cases of similar credentials, abilities, and scientific productivity (Fox Keller 1995) (Etzkowitz, Kemelgor y Uzzi 2000).

3.3 Caregiving and household responsibilities

Despite some improvements in the division of household labour, women still shoulder the main responsibility for caregiving and domestic duties. Not only does this speak to prevailing gender stereotypes, but more importantly the lack of organisational and structural facilities within HE institutions to deal with parental tasks (nursery and breastfeeding facilities, kindergarten, maternity/paternity leave regulations, etc.). As a result, there are significant barriers for women with care responsibilities to effectively pursue their careers.

Cultural contexts, economic constraints, socio-institutional agreements for the participation of woman with children in the workforce -including family moral and physical support - will vary across countries and regions but always are strong factors which determine the continuity and advance of woman in scientific careers.

Gender differences present in "*academic habitus*" (Bourdieu 1990) acquire the form of norms, visions and perceptions directed to organise priorities and decisions related to that dilemma. These are often understood and normalized as "lifestyle values" that bring women to family priorities in career decisions, to occupational sacrifices, or work flexibility, especially when they have children. But men's' preferences, as recent evidence have showed (UNESCO 2018) do not change significantly with or without children.

Several pieces of evidence show that marriage and children do not appear to have a significant influence on women's scientific productivity and academic performance (Krapf et al., 2014). In the case of motherhood, there is evidence showing no significant influence on overall women's scientific productivity. In 10.000 responses to an economy researchers survey, no evidence of low research productivity was associated with motherhood (Matthias Krapf 2014) . But this overall trend changes in specific family contexts, like unmarried woman, maternity before 30 years old or having more than one child. Under these circumstances, when work-family balance became more uncertain and complex, a detrimental effect on research productivity could be observed.

In a recent study in Argentina, several female scientists were interviewed to get testimonies about caregiving duties related to childbearing and career advancement. (Lotitto y Szenkman 2020). Most of them indicated that in the early stages of their academic career - with more professional competition and less possibilities to delegate work- motherhood generated a disadvantage in comparison their male colleagues: access to publications, scholarship or participation in research projects became more difficult.

Moreover, having the primary responsibility for caregiving and household tasks makes it more challenging for woman to attend informal or formal meetings out of the academic schedule. Those meetings are usually the opportunity for academic political negotiations, exchange of information and other critical issues to gain power inside the scientific profession. To sum up, all these constraints build institutional barriers in part formal, in part informal, that affect the gender gap

3.4 Sexual harassment and other gender-based violence (GBV)

Efforts at 'gender mainstreaming' can be undermined by sexist practices such as sexual harassment (Morley 2010). Sexual harassment and other forms of GBV impact significantly on women in HE and on the choices they make about the work they do, an issue that all research funders should be accounting for. The risks involved in undertaking fieldwork shouldn't be undermined, and all institutions need to do a lot more on safeguarding their students.

LAC region has the largest number of feminicides worldwide and the second highest rate of teen pregnancies in the world. It has been reported (Maldonado-Maldonado y Acosta 2018) that women living in Brazil and Mexico are strongly affected by the culture of "machismo", experiencing physical and psychological violence, discrimination, lack of equal opportunities and limited recognition for their work, abilities, and capacities. While access to HE for women is not a significant issue, there are several primary areas of concern: disparities between men and women in promotion and leadership; and sexual harassment of female students and female faculty.

3.5 Obstacles in professional leadership and decision-making roles

Women are under-represented in professional leadership and decision-making roles: in governing and evaluating bodies, as gatekeepers (members of leader councils and scientific organs) in upper academic positions; generally, in power spaces. As the social imagery of science and scientists seems to be male, power is also seen as a male competence. The naturalization of these biases works to the detriment of women, non-traditional men, and gender diversities in research decision-making spaces (European Commission 2008).

Section 2 clearly shows the gender pattern throughout career advancement: women's participation in science begins high at first but decreases as positions increase in seniority. Around the world, a lot of evidence has been collected to make visible the lack of presence of women in senior roles.

A range of dimensions, widely covered by literature, explain the critical and complex challenges that women must face to access a leadership role at science. Alongside the institutional barriers and caring responsibilities highlighted above, formal, and informal gender practices play an important place.

A lack of institutional transparency and accountability affects evaluation procedures applied to funding and promotion for example. These practices facilitate gender discrimination hidden inside the way peers, academic heads and other gatekeepers apply standards of excellence. For example, women candidates are evaluated less competent than men for top positions both by female and male peers (European Commission 2008).

Moreover, in evaluation process where publications outputs are key criteria, there are certain aspects which reinforce gender inequality, such as it being more common for the first author position to be male. Social capital resources as mentioned above, play a specific role in gender discrimination: as part of the "boys clubs" or other similar gendered networks, male candidates acquire additional advantage to be promoted to senior positions (Liza Howe-Walsh y Turnbull 2016).

In other professional places, female leadership is also affected by the conjunction of those factors and results in fewer women having the experience to lead STEM organisations. This has been shown in the case of the academies of science around the world, where less than 10% of their members are women (UNESCO 2018).

4. MAIN ACTORS AND INITIATIVES IN LAC

Over the last decade, different actors in the region, ranging from Governmental institutions, universities and research centres to civil society and international agencies, as well as private companies have launched different types of initiatives aimed at reducing the gender gap in STEM. Some actors within this complex ecosystem have also started acting together to increase the inter-institutional linkages and coordinated efforts needed to address a topic that requires a holistic approach. In addition, programs launched at a global level by international organisations often have had a presence in many LAC countries.

Across LAC, actions initially targeted the retention of women in STEM studies and jobs. Recently, efforts have been directed also at raising the visibility of women's scientific achievements and connecting them through regional and national networks (UN Women 2020). In recent years, countries are also setting up specific inter-institutional committees to work on gender equality in STEM. Although not yet numerous, interesting efforts have been made by NGOs, governments, and international organisations to address the specific challenges faced by indigenous and rural women in scientific education.

The following sections present some of the main institutional actors in the LAC countries.

4.1 Government

An increasing number of governments in the region are recognizing the need for mainstreaming gender equality and reducing the gender gap in STEM as a crucial element for strengthening the national R&I ecosystem and for the benefit of society as a whole.

As a first outcome, the inclusion of **gender perspective in overall public administration** is now well established in several countries, through the design of policy tools such as national equality plans, ministries for women and observatories against gender violence. These types of actions may have sub-national and local expressions through specific secretariats with local agendas. In some cases, in the frame of these actions, specific actions for equity in STEM have been introduced. For example: the *Secretaria Especial de Políticas para mulheres* (SPM-PR) at the Brazilian President's office has launched a call for initiatives titled "Girls and Young Women Doing Exact Sciences, Engineering, and Computing".

Recently, the number of specific policies, programmes, and legal instruments directed to address gender equality in STI has been growing. Some countries have included references to the topic in their national STI plans and policies. Others have taken a step further with the setting up of specific **policy on gender equality** in STI. For instance:

- *Política Institucional Equidad de Género en Ciencia y Tecnología 2017-2025* (Chile);
- *Política Nacional para la igualdad entre mujeres y hombres en la formación, el empleo y el disfrute de los productos de la Ciencia, Tecnología, las Telecomunicaciones y la Innovación 2018-2027* (Costa Rica),
- *Programa Nacional para la Equidad de Género en la Ciencia, la Tecnología y la Innovación* (Argentina).

The creation of **governmental offices and committees** at high administration level has been other way to elaborate specific recommendations for gender equity in STI. For example: the *Consejo Asesor Presidencial de Mujeres Empresarias* at *VicePresidencia - Consejería para la Equidad de la Mujer* (Colombia) , and the *Comité Pro Mujer* at *Consejo Nacional de Ciencia y Tecnología* (Peru).

Specific programmes with focus on **STEM education** enable the creation of more acute equity actions directed to reinforced girls' interest in science studies and technology activities. For instance:

- *Coalición STEM* at *Secretaría de Educación Superior, Ciencia, Tecnología e Innovación* (Ecuador),
- *Niñas STEM PUEDEN* at *Secretaría de Educación Pública* (México),
- *"Hackers Girls Colombia"* at the *Ministerio de Tecnologías de Informacion y Comunicacion* (Colombia),
- *E-chicas* and *Supermáticas* clubs at the Ministry of Education (República Dominicana).

Many countries have launched **actions to support female participations in STEM** careers and entrepreneurship such awards , scholarships and networks For example:

- *Premio Mujeres Científicas de Nicaragua* (at *Consejo de Ciencia y Tecnología*) (Nicaragua),
- *Becas del Gobierno Mexicano para madres* (at *Consejo Nacional de Ciencia y Tecnología*) (Mexico),

- *Innova Mujeres* at *Ministerio de Industria, Energía y Minería* (Uruguay).

Finally, the production of general STI and gender statistics are a starting point for evidence-informed policies. Hence, most of LAC countries have started including sex-disaggregated data in at least some of their STI indicators.

4.2 Higher education institutions

Universities are playing a pivotal role in reducing the gender inequality in STEM at all levels. They are not only putting in place institutional policies and strategies to promote the participation of women in STEM field (García-Peñalvo, Bello and Domínguez 2019) but they are also implementing strategies, policies and mechanisms to attract young women to STEM careers, as well as to retain and promote them in scientific careers.

Universities in the region are putting in place policies and plans for the institutionalisation and mainstreaming of the gender equality approach that are addressing gender equality at different levels.

Some examples are the *Universidad de la República del Uruguay*, which has an Open Commission on Gender Equality (that began operating in 2012), or the *Instituto Tecnológico de Costa Rica*-that has an Office of Gender Equality (since 2013) to promote equal opportunities by improving women's access to education and work in the fields of science and technology.

Efforts have also been made by universities to attract women to STEM through campaigns and strong outreach programmes, open days and career talks in schools, among other activities. For instance, the *Universidad Nacional del Litoral* in Argentina via the Women Scientists of the Past, Present and Future, an initiative focused on changing stereotypes towards women in STEM and attracting more women (sensitising primary and secondary school students to gender and science).

Measures have also been taken to prevent gender bias in student admissions, via gender training for admissions counsellors or gender-balanced selection committees.

Quotas and other measures to influence gender balance have also been introduced. An example is the Faculty of Physical and Mathematical Sciences of the University of Chile, with the *Programa de Ingreso Prioritario de Equidad de Género* (PEG), which offers 70 special vacancies for women on the waiting list (i.e. under the last applicant selected in the regular admission process established by the Council of Rectors of Chilean Universities).

Parental leave, extension of the duration of scholarships for paternity leave, maternity and child care allowances have also been set up by different universities (especially in Argentina, Brazil and Chile).

Furthermore, several networks and spaces for dialogue have been set up within universities, which also collaborate with other social actors, such as schools or non-university faculty among others.

4.3 International organizations

International organisations have participated extensively in bringing the subject to the regional and national agendas.

Among United Nations Agencies, UNESCO has both supported and initiated a range of programmes, from larger scale regional networks to specific regional initiatives and local activities on gender equality in STEM. The *For Women in Science Fellowships Programme* was launched in cooperation with L'Oréal for the recognition of female researchers and their contributions to global challenges. The *STEM and Gender Advancement* (SAGA) project, in cooperation with the Swedish International Development Cooperation Agency, provides tools for governments and policymakers to reduce the existing gender gap in STEM fields. In the same context, *GenderInSite,* in cooperation with the Organisation for Women in Science for the Developing World OWSD, has used a gender lens to look at the consequences of policies and programs in the STEM fields, aiming at revealing the gaps in the equal participation of women and men. OWSD is a global actor and provides fellowships and award programs to promote career women scientist in the developing world.

UN Women launched in 2016 the *Equals Global Partnership* with the International Telecommunication Union (ITU), the International Trade Centre, GSMA (Groupe Special Mobile Association) and the United Nations University. Their work has been ground-breaking in raising awareness about digital gender equality. *Tech4Girls initiative*, implemented in Argentina and Brazil, aims at boosting girls' confidence in STEM by developing tech and computing skills of girls. In association with Costa Rica NGO Cooperativa Sulá Batsú has implemented TIC-as *La Ciencia nos Necesita*. The program focuses on rural women and the development of their technological skills.

Among international funding institutions, the Inter-American Development Bank (IADB) has financed different projects such as *STEM - WISE Latin America* and has also carried out different studies on the topic. The World Bank is also another active actor in the region (see Box 4).

The European Union has supported several initiatives in the region, for instance through the *Erasmus+ Program* and EU Horizon 2020. Two examples are the W-STEM initiative with 9 universities in LAC, engaged in improving strategies and mechanisms of attraction, access and guidance of Women in Latin-American STEM Higher Education program (Chile, Colombia, Ecuador, Costa Rica and Mexico), and the *ACTonGender* project, which works directly with academic and scientific institutions that seek to include more gender equality into their education plans.

Box 4. Encouraging Women's and Girl's Participation in STEM in Lower and Middle Income Countries - the World Bank

Beyond the wage gap that comes with women being underrepresented in STEM, low female representation in these fields is a missed opportunity for economies. Getting more women and girls into STEM would expand and make better use of the available talent pool. At the firm level, it can improve productivity, creativity, and profits (see (Hammond, et al. 2020) for a detailed review of the literature). With so much at stake, it is important to encourage women's and girls' participation in STEM through a holistic approach. The World Bank has been working with different countries in Latin America and the Caribbean to explore policies and tailor them to national goals and priorities. Below some examples of specific initiatives undertaken in the region.

Diagnosing and tackling gender bias within the classroom.

Building on a robust evidence base, the World Bank developed Teach, a free classroom observation tool that aims to support analysis of the quality of teacher practices that help develop the socioemotional and cognitive skills of students (Molina, et al. 2018). One of the four components of the tool measures whether the teacher creates a culture that is conducive to learning by treating students with respect, responding to their needs, and challenging stereotypes. It measures the extent to which the teacher does not exhibit gender bias and does challenge gender stereotypes in the classroom. Measuring teaching practices is a first step toward improving teaching practices. To address findings in the Teach assessment, the World Bank developed Coach, a new program to foster good teaching practices. The plans include addressing and challenging gender stereotypes and biases in the classroom in training materials for teachers. Teach and Coach have been successfully implemented in countries in the LAC Region, including Brazil, Colombia, Ecuador, Guyana, and Uruguay.

Preventing and responding to gender-based violence (GBV) in STEM fields.

A multitude of factors prevent women and girls to enter and remain in STEM fields of education and work, including disproportionate childcare responsibilities in the home, mobility restrictions, and different forms of GBV. The World Bank is committed to invest in preventing and addressing GBV as part of its Safe and Inclusive Schools Initiative, which aims to ensure all girls and boys have healthy environments and feel safe to learn. Addressing discrimination and violence in school and on the way to school in contexts of high prevalence of violence against children lessens one of the main barriers to education and learning. By 2023 its target is to have from 12 to 36 projects with specific interventions to prevent school violence. Currently, a project in the Dominican Republic includes teacher training on school violence prevention.[1] At the higher education level, operations are taking key steps to prevent, report, and respond to sexual harassment and abuse (Rubiano-Matulevich 2019). These include: (i) developing a strong anti-sexual harassment policy (and code of conduct); (ii) establishing a fair, accessible, and transparent complaints mechanism that ensures confidentiality and security while reporting an incident; and (iii) educating and raising awareness among students and staff at all levels on how to recognise, prevent, and respond to sexual harassment.

Allocating resources to provide financial incentives for bringing more women into STEM operations.

This is particularly critical given that higher parental educational attainment and higher household income are often associated with the level of children's engagement and performance in science (Betancur, Votruba-Drzal and Schunn 2018). In Peru, the Strengthening the Science, Technology, and Innovation System project aims to contribute to gender equality by increasing the participation of women in Peru's Science, Technology, and Innovation (STI) system. In particular, the operation provides specific incentives to female researchers encouraging and increasing their participation by: (i) assigning an additional weight on candidacies by female researchers (that is inversely proportional to the number of women researchers in the field) in the selection process for the doctoral scholarships and (ii) financing entrepreneurship grant windows that will prioritise proposals led by women. In St. Lucia, where there is evidence of a low representation of females employed in technical positions in the energy sector, the World Bank is supporting government's efforts to provide educational, training, and employment opportunities for women through the Renewable Energy Sector Development Project. Activities include: (i) offering a new annual scholarship program dedicated to women to pursue electrical or mechanical engineering degrees; (ii) offering extended 3 to 9-month apprenticeships for women enrolled in the electrical and mechanical engineering programs; (iii) conducting outreach programs at the secondary school level to inform soon-to-be graduates of the educational and employment opportunities in the engineering and energy sectors; and, (iv) hosting annual job fairs to support its graduates to find gainful employment in the energy sector.

1 https://blogs.worldbank.org/voices/taking-fight-against-gender-based-violence-schools https://www.worldbank.org/en/topic/education/brief/safe-and-inclusive-schools-initiative-ensuring-healthy-environments-for-all-boys-and-girls-to-learn

4.4 Private Sector

The private sector has emerged as a new and significant actor launching both smaller and larger initiatives targeting the various stages of the life cycles at both regional and national level.

Some examples in the region, include:

- STEM program provided by *Mastercard* targets girls at a young age, teaching them about the company's technology.
- Women TechMakers by *Google* provides visibility and motivates women interested in technology through various events.
- Companies are well equipped and experienced in developing young girls' leadership skills, such as through *Oracle's Woman Leadership Initiative* in Colombia, providing motivational talks.

- *Intel* gives vocational training and connects students in their last year of studies with Intel engineers. Thus, the private sector offers new opportunities for further collaboration and innovative projects.

- *Coderise* implemented by the Coderise Foundation in cooperation with Holberton School, targets especially underprivileged youth in Colombia and the Dominican Republic through software programming education and digital skills. Their program Code your Future in Colombia also gives opportunities to refugees and disadvantaged youth who want to become software developers. The organisation also offers English speaking skills boot camp for young people who want to work abroad.

4.5 National and international cooperation agencies and embassies and civil society organisations

Different civil society organisations in the region working towards promoting women in STEM focus on different aspects of the development of women as scientists, from attraction to retention and advancement. Among others:

» *Women Who Code* is an organisation working globally to enhance the role of women in roles as technical leaders, executives, founders, board members, and software engineers.

» *TECHnovation Girls* is a program exclusively for young women to inspire the pursuit of STEM. It runs the largest global technology and entrepreneurship competition for junior high and high school aged girls (10-18 years of age).

Cooperation agencies in several countries have also made contributions, in partnership with local public or private organisations, towards addressing the gender gap in STEM. Some examples include:

- *Swedish International Development Cooperation Agency (Sida)* works in cooperation with international organisations like OWSD and UNESCO on gender and STEM issues.

- *The International Development Research Centre (IDRC)* from Canada has a strong intervention in gender-focused research support in the region. It has launched the *Postdoctoral Stays Program for Indigenous Mexican Women in STEM* in cooperation with the Mexican governmental agency *CONACyT* and the *Centre for Research and Higher Education in Social Anthropology (CIESAS).*

- The *Organización de Estados Iberoamericanos* (OEI), as the main regional multilateral cooperation agency, supports different national projects to implement gender equity plans in gender, science and education. OEI also supports the bi annual Iberoamerican Gender, Science and Technology Congress, an initiative from a regional network of gender S&T academics.

- Several embassies and foreign governments representations in LAC have support initiatives, for instance, in Peru, the British Embassy has supported the program *STEM es para Chicas* aimed at primary and secondary school level and the US Embassy has supported the program *Stem para todas* aimed at secondary students. In Mexico the US Embassy has also contributed to the program *Mujeres en STEAM* in Yucatan.

4.6 Overview of actions in LAC

There are significant divergences among countries in terms of the presence of those actions and their efficacy. Gender mainstreaming in STEM is strongly related to the overall linkage of factors such as the maturity of the STI system in a country, the size of its S&T workforce, its history,

Box 5. Women in Science Programme in the Americas -the British Council

The British Council Women in Science Programme in the Americas aims to promote a more diverse and gender-representative science by: increasing the presence of girls in STEM; supporting STEM scientists with training; strengthening networks of researchers in collaboration with the UK; and developing policies to promote increased access and influence of Women in Science.

Despite an increased presence among researchers in the region, we recognise that women still face many challenges when pursuing a career in STEM, and that these are complex and varied, and consequently are not easy to address.

To tackle these challenges, we have adopted a life cycle approach, with initiatives aimed at young girls, right through to experienced researchers. We approach our work with an intersectional lens, recognising the diversity within gender identities and backgrounds.

Our impact is defined across four dimensions:

1. Inspiration: childhood, training, and early-stage career decisions
2. Recognition: support for career development and formal and informal credentials, as well as academic outputs
3. Influence: increased representation of women at all levels in higher education and Research/ policy settings, and representation to support inspiration
4. Institutional development: supportive working cultures and improved settings and outcomes for women in science.

Across Latin America and the Caribbean, we have collaborated with partners such as UNESCO, King's College London and the Museu do Amanhã (Museum of Tomorrow) and to implement projects spanning the life cycle: from delivering teacher training for gender sensitive or transformative pedagogies for school-aged children in Brazil and Colombia, to providing mentorship for researchers in México and Perú, and designing a Gender Equality Framework for Higher Education systems in Brazil.

In 2021 we also launched the global Women in STEM Scholarship, so far providing a full bursary to 48 women from 8 countries in the region who would otherwise have been unable to study a Master's in the UK. Indeed, since 2018 we have engaged with more than 14,000 female researchers, academic staff and students; our content has been viewed by more than 70,000 people; and our STEM Scholarship campaign has reached 20 million people across the region.

We work via a multi-stakeholder approach, bringing policy makers from different countries together to participate in forums and policy dialogues on STEM and gender equality. We aim to establish by 2022 the UK-AMERICAS Women in Science Association, a region-wide initiative capitalising on shared practice, providing context specific learning, and serving as a key space to strengthen influence and transformational policies for Women in STEM in partnership with UK women organisations, academics and researchers.

For more information on the program visit our website for opportunities, podcasts and the Women in Science magazine.

https://www.britishcouncil.org.br/mulheres-na-ciencia

the political and cultural background, and the institutional framework (UNESCO 2018).

An overview of these initiatives shows that there is a focus aimed primarily towards secondary education level, and the PhD/post-doctoral level, as well as at women researchers. Besides networks and roundtables, there are also award programs and fellowships to recognise the performance of young and ambitious women researchers and scientists. Several programs have also targeted the surging group of young women entrepreneurs, or STEMpreneurs, by supporting them through initiatives and, occasionally, by providing them with funds for their start-ups and e-businesses. Mentor programs have been particularly relevant to ensure references for young women pursuing a career in the STEM fields.

5. CONCLUSIONS AND RECOMMENDATIONS

The LAC region has experienced significant improvements regarding the inclusion of women in STEM at different stages of the life cycle and, nowadays, is one of the two regions in the world with the highest percentage of women researchers. Different actors have played a significant role in promoting gender equality. As a result, gender is being mainstreamed in LAC public agendas confirming the importance of the last decade's work to raise awareness of gender gaps in STEM. Most of the countries in the region have undertaken actions at the policy level to improve the setting, including equality laws and plans, STEM initiatives at university level, among others. Private and international actors have also played an important role in the process of bringing visibility to the topic.

5.1 Challenges ahead: a regional outlook

Despite this progress, the region still presents a highly varied context in terms of uptake of STEM by women and girls, and gaps and barriers are still present at the different stages of the life cycle as a consequence of multiple variables. In some counties more than in others, the path to gender equality in academic and research careers, particularly in STEM, still need to be paved. Furthermore, horizontal and vertical segregation still persist in all the countries of the region.

A significant **lack of awareness** among the younger generations regarding the potentials of STEM studies has emerged and there are several different factors making STEM studies and jobs less 'attractive' for girls and young women. This is compounded by the fact that in several LAC counties there is an overall misunderstanding across society of the STEM careers themselves, which tend to be considered more difficult and harder than other studies and professions, such as those related to social sciences. Of course, this is a clear cultural barrier affecting STEM vocations for all young people. Linked to this, there is the stereotyped social representation of gender about educational performance and career choices. Although the situation is changing, boys and young men are frequently perceived as having the required aptitudes to tackle STEM studies and STEM careers are still perceived as male domains.

Stereotypes are pervasive across society and misconceptions are also held by families and teachers. Actions addressing the challenges of stereotypes particularly focused on these groups are thus highly needed.

At education level, among others, two characteristics in particular, hinder girls' enrolment in STEM studies and reinforce the gender gap trends. First, a **lack of gender-responsive STEM pedagogies, tools and infrastructures**, which affects most public and private schools, especially those localised far from urban and cultural centres and in rural areas, and impact on teachers' capabilities to make STEM studies more interesting, specially for girls. Secondly, the persistent poverty and structural dualism (strong socio economical differences among intranational regions) affect social access to TICs resources (digital competences, communication infrastructures and computational appliances). Moreover, girls and woman tend to be more affected by poverty than overall population.

Given the socioeconomic features of the region, it is highly important to consider **intersectional discriminations**. Generally, afro-descendent girls and women or those from indigenous communities, face serious barriers when aiming at STEM careers. Therefore, public authorities and a variety of societal actors are increasingly making the case for a more inclusive scientific culture, which may be achieved by changing discriminatory attitudes, internal working and staff selection procedures of educational and research institutions. Also, language barriers need to be addressed, as indigenous girls are often excluded from education at the primary level because classes are not in their mother tongue but only in the national language.

The lower the socio-economic background, the more relevant all these barriers are for the development of girls and women through education. On the top of these, **sexism in society**, and particularly in the academia, is a serious issue hampering the progression of female students in STEM disciplines and the access of women researchers to more senior and leadership positions. In several cases, such as in STEM faculties, this '*cultura machista*' is reflected in the organizational structure and working procedures, which gives unbalanced panels for choosing new professors, with men outnumbering women.

As in several other low and middle-income countries, low engagement with scientific careers can also be due to the overall **low level of digitalisation** across students and society as a whole. Addressing such challenge may contribute to address the gap in uptake of STEM careers between boys and girls and change stereotypes about STEM careers themselves.

In cases where women chose to pursue STEM studies, it may be difficult for them to **progress in a career**. Female professionals having achieved higher positions, have often complained of having worked harder than male colleagues and of having benefitted less than men from financial opportunities for research.

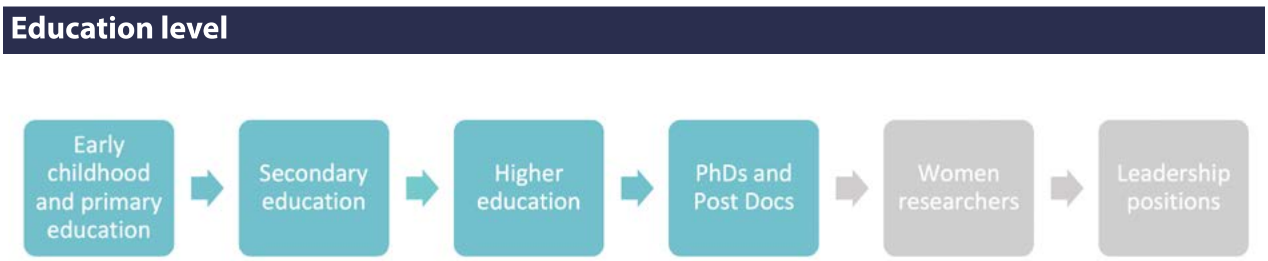
Among the contextual factors to be taken into consideration, beyond societal misconceptions and persistent, harmful stereotypes, some may point at the **lack of specific policies for gender equality in STEM**. Sporadic and time-limited, activities, limited budgets and weak specific STEM focus are some of the negative features of these interventions. Moreover, these initiatives are also failing at including rural women, parents, teachers, and men.

This weakness of gender policies is frequently related to institutional instability which in turn generates an absence of long-term policies. Science is a complex achievement that needs strong planning, clear engagement with implementation activities and regular monitoring of applied policy results.

One of the main problems with the existing initiatives is the **lack of information** about their **results and outcomes**, as well as information about their success in **achieving their objectives**. Many initiatives were ambitious in the initial phase of implementation, but not necessary successful in reaching their results and in having any impact. It is therefore important to learn from good practices and successful elements, but we must also learn from what has not worked. In this way, it will be possible to avoid repeating the same mistakes. This requires, nevertheless, transparency from actors implementing these initiatives. This lack of impact assessment (and its links with weak coordination and articulation activities) leads to a frequent overlapping of gender initiatives between different actors withing the public and private actors. Furthermore, sex-disaggregated data on gender equality in STEM is also needed to effectively map the needs and for the development of evidence-based policies.

5.2 Recommendations

The COVID-19 pandemic has highlighted the key role of STEM and of women in STEM in response to this and other crises. The following recommendations are a starting point for overcoming the multiple challenges related to gender equality in STEM in the region highlighted previously.



Evidence has shown specific educational gaps in STEM. Addressing them could contribute to increasing employment and productivity and reducing occupational segregation.

One of the main recommendations is to **address the social and cultural stereotypes** in LAC countries present at all stages of the life cycle. STEM engagement, interest, and future career aspirations are shaped by gender norms, biases and stereotypes. Education can play a fundamental role in encouraging children and young people's interest in STEM and in attracting more girls to STEM.

Initiatives, even in the early stages, should consider **working with teachers and families** to identify and tackle stereotypes at school. Early actions could provide a first step towards fostering girls and young women´s passion for STEM studies and to reinforce scientific and digital skills.

The lack of role models gender bias in parental expectations and a lack of female secondary STEM teachers have been often recognised as one of the key challenges. The **inclusion of gender dimension in STEM teaching skills and pedagogical strategies** could not only improve the condition for equality but also the quality of education in LAC countries. At all the stages of the life cycle, inspirational initiatives in education should be linked to technical skill empowerment.

In recent years, some initiatives are also favouring a STEAM approach (Science, Technology, Engineering, Art and Mathematics) in education, which promotes interdisciplinary learning that encourages creativity, collaboration and the design of effective solutions to solve problems or needs in social and environmental settings.

Some of the actions that could be implemented to address gender gaps in STEM at education level include:

» Inspirational talks about role models, science vocations and stereotypes for girls in schools

» Coding and tech festivals, digital skills trainings, and digital inclusion activities for students

» Mentoring programs on STEM skills and careers for undergraduate level students

» Public exhibitions and seminars, hackathons, and Wikipedia edit-a-thons

» Assistance to young female students in STEM research projects

» Outreach and engagement work with STEM stakeholders, schools and Universities

» Trainings for teachers around gender dimension on STEM education and pedagogical strategies

» Designing and implementing GBV guides in schools and universities

STEM career development level

Different challenges such as stereotypes and lack of role models affect girls' interest in STEM from an early age. However, even when women graduate with degrees in STEM, many are not employed in STEM-related fields.

Gender discrimination, harassment, bias in recruitment and the workplace as well as lack of appropriate **re-entry mechanisms**, and **institutional barriers** (structure, governance, policies, norms and values) also discourage women from entering, remaining or progressing in STEM related jobs.

Gender equality in recruitment, retention and promotion pathways should be enhanced. **Work-life balance** measures and equal work conditions need also to be promoted. In addition, to facilitate the progression of women in decision-making positions at academic or corporate boards, it is the necessary to train them in the personal development of **leadership skills**.

One of the strategies to strengthen the career development of women scientists and technologists are **mentoring programmes** based on systematic plans that integrate a gender equality approach. Although these experiences are still incipient in LAC, the results from other regions show that this type of mentoring promotes learning and competencies that allow women to design strategies to successfully achieve their objectives and overcome the obstacles they frequently face in the development of their careers (micro-inequalities, gender biases in the selection and promotion criteria that are detrimental to them, various manifestations of harassment, among others). To be effective, mentoring must be supported by an action/interaction plan with clearly stated objectives and duration, defined roles (mentors and mentees) and agreed-upon responsibilities and goals. Its duration, modalities and interaction times are established and agreed upon from the beginning, as well as the principles of confidentiality.

There is a need for the different actors relevant to STEM careers – including academic peers, managers, scientific leaders, members of evaluating boards etc.- to improve visibility and recognition of women in STEM, and more broadly, to achieve their effective participation in decision-making and agenda-setting in science, technology and innovation.

Some of the actions that could be implemented to address gender gaps in STEM at **career development level** include:

» Scholarships and mentoring programs for female students and researchers - to foster STEM vocations and professional performance

» Workshops on entrepreneurship and innovation for women in STEM

» Exchange opportunities for high level career researchers (visits to labs, universities S&T parks in different countries)

» Specific and practical training for young professionals in soft skills

Policy and systemic level

As discussed in the previous sections, a new paradigm based on a systemic approach is necessary to achieve structural changes, as well as more specific national STI gender equality policies and long-term national strategies. In this sense, initiatives should begin **with a inter-institutional dialogue**. To ensure the sustainability of initiatives, there is an urgent need for national strategies and policies that can outlive changes of government. For the best interventions it is necessary to coordinate actions and resources among public agencies and offices.

Enforcing gender-sensitive and gender-transformative STI public policies implies not only the definitions of goals and resources for their implementation but it also requires a political will to evaluate and share the results, outcomes and impacts of policies.

Furthermore, it should be stressed that any STEM strategy cannot forget about the gender gap, nor can the gender gap be addressed independently of the global STEM strategy.

Some of the actions that could be implemented at **policy and systemic level** include:

» Workshops with policymakers, corporate managers and gatekeepers on inclusive approaches for STEM interventions (e.g., on flexibility on the workplace; on recognition of importance of maternity leave and acknowledge its impact in publishing and other relevant scientific metrics; etc)

» Long-term policies that address the gender gap as well as monitoring and evaluation of policy implementation

» Coordinating regional activities with different actors directed to policy discussion and exchange of experiences and good practices of gender equality in STEM

» Initiatives to support public and private organizations for STI equity

» S&T Indicators initiatives (workshops, trainings, events) on gender issues directed to S&T managers from government, university and private sector

» Charter on gender equality in STEM (such as the 'UK-Americas Women in Science Association or Athena SWAN)– components related to inspirational initiatives at country and regional level.

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SUSTAINABLE DEVELOPMENT GOAL 5: Achieve Gender Equality and Empower all Women and Girls

Gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world.

There has been progress over the last decades: More girls are going to school, fewer girls are forced into early marriage, more women are serving in parliament and positions of leadership, and laws are being reformed to advance gender equality.

Despite these gains, many challenges remain: discriminatory laws and social norms remain pervasive, women continue to be underrepresented at all levels of political leadership, and 1 in 5 women and girls between the ages of 15 and 49 report experiencing physical or sexual violence by an intimate partner within a 12-month period.

The effects of the COVID-19 pandemic could reverse the limited progress that has been made on gender equality and women's rights. The coronavirus outbreak exacerbates existing inequalities for women and girls across every sphere – from health and the economy, to security and social protection.

Women play a disproportionate role in responding to the virus, including as frontline healthcare workers and carers at home. Women's unpaid care work has increased significantly as a result of school closures and the increased needs of older people. Women are also harder hit by the economic impacts of COVID-19, as they disproportionately work in insecure labour markets. Nearly 60 per cent of women work in the informal economy, which puts them at greater risk of falling into poverty.

The pandemic has also led to a steep increase in violence against women and girls. With lockdown measures in place, many women are trapped at home with their abusers, struggling to access services that are suffering from cuts and restrictions. Emerging data shows that, since the outbreak of the pandemic, violence against women and girls – and particularly domestic violence – has intensified.

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